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SCIENCE FACT

MARCH 1971 60¢ 6/-

## THE MISSING MAN

Katherine MacLean

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# Litter is:

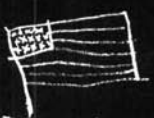
Litter is not pretty.
Litter is not Healthy.
Litter is not clean.
Litter is not American.
William Mahoney

Litter Is Something People should not Do.
Insigned
Suzie McGuire

litter is nasty.
Willie Warner

Litter is what Bad people do Litter Wight

Litter is ugly and ~~dangerous~~ bad.
Tommy Mallby



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Editor
KAY TARRANT
Assistant Editor
HERBERT S. STOLTZ
Art Director
WILLIAM T. LIPPE
Advertising
Sales Manager

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# THE STAY-HOME BODIES

*An editorial by John W. Campbell*

There's considerable political effort at work today trying to stop Man from going deeper into space. That the anti-technological liberal/humanist types are against it is understandable—they're against any expenditure of time-effort-money on technological developments of any kind. They have an abiding fear-hatred of Science per se.

But there's a considerable pressure against the manned space program among scientists themselves—and that takes a little understanding.

The most readily understood opposition to the manned space program arises from the nature of the personality of a man who's dedicated himself to research he truly feels is of great importance. After all, a man doesn't spend the years of his life working at something he feels is unimportant, useless, or of mere passing interest. No man takes on the job of working on a field trip in the central Amazon jungles looking at botanical specimens among the acute dangers and discomforts of that area without strong motivation. It must seem *important* and truly worthwhile to him. And a man doesn't spend the winter at the South Pole observing the weather conditions just because he doesn't have anything else to do with his time. He does it because it feels truly necessary to him. Necessary and immediate—something that needs to be done *now*.

Every genuinely dedicated scientist in every field of science is in that field because, to him, it seems the most worthwhile, most rewarding thing he can do. (And "rewarding," to such men, is *not* spelled "$UCCE$$".) It's the satisfaction of feeling he's advanced Man's understanding of what the Universe is, and how it works, and how other life forms interact.

Inevitably, to a man who has that strong and sincere feeling of the genuine importance of his field of study, there's a gross error involved in spending huge sums on space research when his field so critically needs funding. This leads



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to a sincere, though not-quite-rational, feeling that if only that money weren't spent on space research, it would be poured into an area where it's really needed—his field of *important* research.

The result is that such sincerely dedicated scientists oppose the national space research effort—and since manned space flight is the most expensive area of space research, he wishes they'd cut that out altogether, and settle back to the instrumented probe research that's already been researched.

At first thought, you'd expect the astronomers and astrophysicists, at least, to be in favor of strong commitment of space research—but there are problems!

For the price of building, launching, and tracking one orbiting astronomical satellite—about $150,000,000—you can build a new observatory with a giant 150-inch telescope, equip it, and man it. The Earth-bound observatory will function for many decades; generations of graduate students can work with it. Scores of astronomers will be able to have time on it to conduct their researches. Like the giant computers, giant telescopes never have enough time available for all the men who have important research projects held up for lack of observational studies.

It's true that orbiting observatory instruments can gather data that no Earth-bound observatory ever can. You'll never be able to study the X-ray radiation from the Crab Nebula supernova remnant from beneath Earth's atmosphere, or investigate the ultraviolet spectrum of class 0 and Wolf-Rayet stars—or even that of the Sun.

But the orbiting observatory allows only half a dozen or so men to have their experimental programs built into the mechanism. It serves the important research program of only a few men, while hundreds can have a chance at an Earth-based telescope. And for a man whose special field of investigation is the behavior of multiple stars—what use is the orbiting observatory anyway? They can't be aligned with any *real* precision, so how can you measure minute displacements?

Another major gripe against the manned space program was expressed by one of the men whose name is strongly identified with the space program; Dr. Van Allen, of Van Allen Belt fame.

Dr. Van Allen feels that if we drop the manned space program, and concentrate on instrumented probes, scientists, instead of engineers, can be in control of the exploration—remote-control probes won't require highly trained test-pilot types to run them, since they will be controlled from Earth-based laboratories. Thus really qualified scientists can examine and study what they encounter.

Up to the time that Apollo 13



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demonstrated that space-exploration was *not* a routine, simple, safe procedure, scientists had been griping very loudly that they hadn't been permitted to go on the expeditions to the Moon. This demand has quieted down somewhat since three highly trained test-pilot types managed to bring their crippled bird in for a viable landing. NASA was, evidently, perfectly correct in its assessment of the realities; it will still be some time before space transports are ready for non-test-pilots. It takes more of the grease-monkey type than of the pencil-pusher to flange up a blow-out patch gimmick to make the unworkable function.

The top scientists, however, see in the instrumented probe something that *they* can control, and do what they know they can do best.

To a large extent, that's the old human reaction syndrome which causes you to start pushing a hole in the floorboards with your right foot when someone else is doing the driving. You just *know* you could do a better job if you had your hands on the controls. The private-plane pilot has an extremely uncomfortable expression on his face when he rides a modern commercial transport, at takeoff and landing especially. *He'd* never make a wild-eyed takeoff like that!

And the laboratory scientist feels just as deeply that he could do a damn sight better if *he* were at the controls of that mission!

(With the exception, of course, of Apollo 13. But that was a special case.)

And besides, manned exploration is much more expensive than instrumented probes anyway; manned spaceflight to other planets is going to take a huge investment in research to go from the open-system life-support of the Apollos to a closed-cycle life-support system. But we already have the technology to land an instrumented probe on Mars.

The reasons why scientists oppose the manned space research as against instrumented probes are various, but sincere enough—even simple jealousy is an honest human emotion, after all! Mistaken, yes—but not insincere.

The opposition from the liberal/humanist types is also understandable. Basically, such people are shortsighted, and have a fundamental philosophical misunderstanding.

There are two totally different types of True Facts in the Universe. They are both genuine, *facts;* both are important to human beings—and they can be, and very, very commonly are confused.

Type One is the immovable, absolute, ruthless, and unarguable Facts of the Universe. There is a law of gravity; we don't know what its exact nature is—if we did, we could do more about it!—but it *is* and it won't go away no matter



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how hard you wish, or how determinedly you deny its existence. These facts are coldly impersonal. They have no heart, they are not merciful—nor are they cruel—and they flatly refuse to make exceptions. They're strictly inhuman and inhumane.

With absolute ruthlessness, they hold that if a three-year-old pulls a pot of boiling water off the stove onto himself, he shall be critically scalded, despite his youth and innocence.

The other type of fact is the set of Truths-by-Consensus. The correct spelling of the word "color" is, in England, "colour," though that is not a fact in the United States. You have a right to freedom of speech in the United States, but that is stringently limited in the U.S.S.R.—and those facts are true because of consensus. A piece of furniture intended to support objects placed on it is "a table" in the United States, but the true fact is it is *"una mesa"* in many parts of the world.

Now these Type Two facts—facts-by-consensus—are subject to change, and exceptions can be made, and humane considerations can induce changes in their application—they are human and humane facts.

Consensus facts are subject to argument, appeal, and pressure of opinion. With respect to these facts, individual opinion is a meaningful concept—"My opinion is as good as yours" makes sense, and the old question "Who is to judge?" is a meaningful one.

And that is the area of the liberal/humanist's philosophy.

With respect to Universe facts, the only correct statement as to individual opinions is "My opinion is as bad as yours!" and the question "Who is to judge?" has no answer, any more than the old "How high is up?" because it's an equally meaningless question. The meaningful question is "On what basis should one judge?" because the only "opinion" that is valid, or meaningful, is the Universe's opinion.

The scientist-technologist gets his face rubbed into that fundamental reality continually; he knows that the facts he works with are not opinions—they're facts-in-the-universe, and neither his opinion nor that of any other man has the slightest influence on them. Even though you got a 100% consensus that the Earth was flat, the curvature of the horizon wouldn't change.

The result is that *to the humanist*, a scientist-technologist appears to be coldly, ruthlessly, arbitrarily unwilling to yield to human desire and need. He appears to be rigid and absolutistic in his whole attitude, unwilling to compromise or show humane feelings. He's undemocratic, because he refuses to

*continued on page 175*



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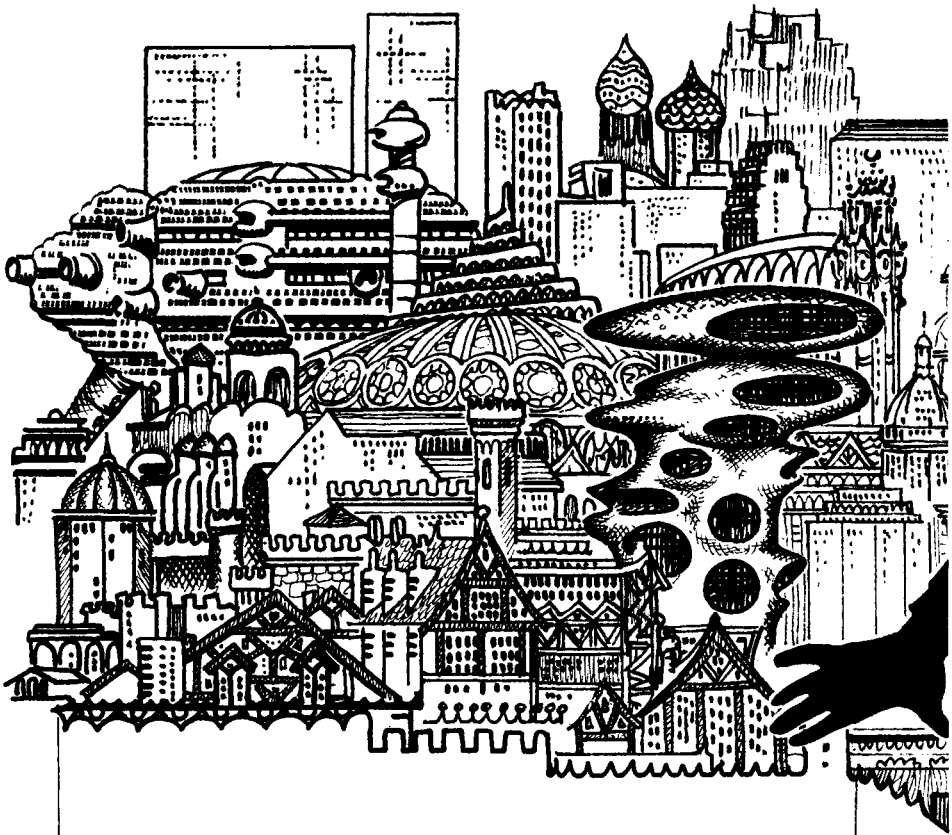

# The Missing Man

*The trouble with complex automation is that it follows blindly any order to its logical catastrophe!*

KATHERINE MACLEAN
*Illustrated by Kelly Freas*

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"YOU ARE NOT ALONE" announced the sign, flashing neon red in the dark sky. People in the free mixed streets looked up and saw it as they walked back from work. It glowed red behind them in the sky as they entered the gates of their own Kingdoms; their own incorporated small country with its own laws inside its gate. They changed into their own strange costumes, perhaps light armor, and tourneyed, tilting lances against each other, winning ladies. Or in another Kingdom with a higher wall around its enclosed blocks of *city, the strange lotteries and rites* of the Aztec sadist cult, or the simple poverty and friendliness of the Brotherhood Love Communes. They were not alone.

Nonconformists who could not choose a suitable conformity lived in the mixed public areas, went to mixing parties, wondering and seeking. Seeking who? To join with to do what? Returning from the parties late and alone, they passed the smaller signs flashing red in the store windows. *"You Are Not Alone. Find your own Kind, Find your own Hobby. Find your own Mate, Find your own Kingdom. Use 'Harmony' personality diagnosis and matching service."*

Carl Hodges was alone. He stood in a deserted and ruined section of the city and saw the red glow of the sign reflecting against the foggy air of the sky of New York, blinking on and off like the light of a flickering red flame. He knew what the glow said. *You are not alone.*

He shut his eyes, and tears trickled from under his closed eyelids. Damn the day he had learned to do time track. He could remember and return to Susanne, he could even see the moment of the surfboard and his girl traveling down the front slope of a slanted wave front, even see the nose of the board catch again under the ripple, the wave heaving the board up, up and over, and whipping down edge first like an ax. He *knew how to return for pleasure to* past events, but now he could not stop returning. It happened again before his eyes, over and over. *Think about something else.*

"Crying again, Pops?" said a young insolent voice. A hand pushed two tablets against his mouth. "Here, happy pills. Nothing to cry about. It's a good world."

Obediently Carl Hodges took the pills into his mouth and swallowed.

Soon memory and grief would stop hurting and go away; think about something else. Work? No, he should be at work, on the job instead of vacationing, living with runaway children. Think about fun things.

It was possible that he was a prisoner, but he did not mind. Around him, collecting in the dark, stood the crowd of runaway children and teenagers in strange mixed costumes from many com-



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munes across the United States. They had told him that they had run away from the Kingdoms and odd customs of their parents, hating the Brotherhood, and conformity, and sameness of the adults they had been forced to live with by the law that let incorporated villages educate their own children within the walls.

The teeners had told him that all rules were evil, that all customs were neurotic repetition, that fear was a restriction, that practicality was a restriction, and mercy was a restriction.

He told himself they were children, in a passing phase of rebellion.

The pill effect began to swirl in a rosy fog of pleasure into his mind. He remembered fun. "Did I tell you," he muttered to the runaway teener gang that held him as a prisoner-guest, "about the last game of Futures I played with Ronny? It was ten thirty, late work, so when we finished we disconnected the big computer from its remote controls and started to play City Chess. We had three minor maintenance errors as our only three moves. He wiped out my half of the city, by starting an earthquake from a refrigerator failure in a lunchroom. It wiped out all the power plant crew with food poisoning, and the Croton power plant blew up along a fault line. That was cheating because he couldn't prove the fault line. I wiped out his technocrats in Brooklyn Dome just by reversing the polarity on the air-conditioning machine. It's a good thing our games aren't real. Everyone is wiped out totally by the end of a good game."

A blond kid who seemed to be the leader stepped forward and took Carl Hodges's arm, leading him back toward his cellar room. "You started to tell me about it, but tell me again. I'm very interested. I'd like to study Maintenance Prediction as a career. What does reversing the leads on the air-conditioning machine do to destroy a place?"

"It changes the smell of the air," said Carl Hodges, the missing man who knew too much. "You wouldn't think that would make a lot of difference, would you?"

Since June 3rd, every detective the police could spare had been out looking for a missing computer man who had been last seen babbling about ways to destroy New York City.

Judd Oslow, Chief of Rescue Squad, sounded excited on the phone. "Your anti-chance score is out of sight, George. I want you to guess for us where Carl Hodges is and give us another hit like the first three. I'm not supposed to send my men after Carl Hodges, it's not my department, but that's my neck on the block, not yours. Brace yourself to memorize a description."



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"Sure," George made ready to visualize a man.

"Carl Hodges, 29 years old, 140 pounds, 5 feet 9 inches tall, brown hair, hazel eyes."

George visualized someone shorter and thinner than himself. He remembered some short underweight men who were always ready to fight to prove they were bigger.

"His job is assistant coordinator of computer automation city services," read Judd Oslow.

"What's that?" George wanted to get the feel of Carl Hodges's job.

"Glorified maintenance man for the city, the brains for all the maintenance and repair teams. He uses the computer to predict wear and accidents and lightning-strikes and floods that break down phone lines, power and water lines and he sends repair teams to strengthen the things before they are stressed so they don't break. He prevents trouble."

"Oh." George thought: *Carl Hodges will be proud of his job. He won't want to be bigger.* "How does he act with his friends? How does he feel?"

"Wait for the rest." Judd read, "Hobbies are chess, minimax, and surfing. No commune. Few friends. One girl who met with a fatal accident when they were on a love trip last month. He's not happy. He was last seen at a Stranger's introduction party, 36th Street and Eighth. He might have been spaced out on drugs, or he might have been psychotic, because he was reported as mumbling continuously on a dangerous subject he was usually careful to keep quiet about."

"What subject?"

"Secret."

"Why?"

"Panic."

"Oh," George restrained his natural anger at being confronted with a secret, and remembered an excuse for the authorities. Panic, or any other group stimulation that could send many people unexpectedly in the same direction, could cause destructive crowding and clogging in the walkways and transportation. People could get jammed in, pushed, trampled, suffocated. In a city of tremendous population and close and immediate access to everything, safety from crowding was based on a good scatter of differences, with some people wanting to be in one place and others in another, keeping them thinly spread. Sometimes the authorities kept secrets, or managed the news to prevent interesting things from pulling dangerous jammed crowds into one place.

The chief of Rescue Squad got the TV connection to the public phone turned on, and let George look at a photograph of the missing man. A wiry undersized scholar with a compressed mouth and expressionless eyes. George tried to tune in by pretending it was his own face in the mirror. Staring into its eyes he felt lonely.



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He started by going to the Stranger's introduction party. He followed his impulses, pretending to be Carl Hodges. He wandered the city closely on the trail of Carl Hodges, but he did not feel it with any confidence, because he thought that the trail of feelings that urged him from one place to another were his own lonely feelings and sad thoughts. After he was given a few bad events to be sad about, he was sure it was his own mood.

George woke at dawn and watched pink sunlight touch the bushes along the top of a building so they brightened up like candle flames on the top of a birthday cake. He lay with his eyes open and watched while the light brightened and the pink faded. Crickets sang and creaked in the deep grass and bending tall grass tickled against his face.

He lay still, feeling the kind of aches you get from being kicked. There were a lot of aches. The teener gang that had attacked him had even put chain bruises on his legs. They had not been trying to kill him, only to warn him against trespassing again.

But George still felt strange and without friends. Usually he could join any group. Usually he could be anybody's friend. Was he forgetting how to be buddy with strangers? The teeners had left him on the sidewalk tied in a ridiculous knot with fingers and toes hooked together by Chinese fingertrap tubes. He had worked his fingers free, and walked down to his girl friend's Brotherhood Love Commune to sleep. He felt strange and inferior, and hoped no one would look at him, when he entered the commune. The brothers in the front rooms said he was giving out bad vibes, and upsetting an important group meditation, and they gave him a cup of tea and put him out with his sleeping bag.

Four a.m., wondering what he was doing wrong, he went to sleep in a shape-hiding shadow in the grass belt opposite the Rescue Squad midtown headquarters. Now awakened again by dawn, he felt his bruises and felt sad and unsuccessful. He had wandered through many places in the city the night before, but he had not found Carl Hodges. The computerman was still an unlucky prisoner somewhere.

By the time the sun was high, George was going across George Washington Bridge the hard way, on the understruts of the bridge, clinging with bare hands and feet, clambering up and down slopes of girders and cables, sometimes sitting and watching the sun sparkle on the water more than a hundred feet below while huge ships went slowly by, seeming like toy ships.

The wind blew against his skin, warm sometimes and sometimes cold and foggy. He watched a cloud shadow drift up from the



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south along the river, it darkened the spires of tall buildings, became a traveling island of dark blue in the light blue of the river, approached and widened, and then there was cool shadow across the bridge for long moments while George looked up and watched a dark cotton cloud pass between him and the sun.

The cloud left and the light blazed. George looked away, dots of darkness in front of his eyes, and watched the cloud shadow climb a giant cliff to the west and disappear over the top. He started picking his way along a downslope of girder, moving carefully because the dazzle of sun dots was still inside his eyes, dancing between his vision and the girders. Overhead the steady rumble of traffic passing along the roadway was a far away and soothing sound.

A gull in the distance flapped upward through the air towards him. It found an updraft and drifted upward, wings spread and motionless, and paused in front of him, floating, a white beautiful set of wings, a sardonic cynical head with downcurved mouth and expressionless inspecting eyes.

George was tempted to reach out and grab. He shifted to the grip of one hand on the cross strut and hooked one knee over a bar.

The gull tilted the tips of his wings and floated upward and back, a little farther out of reach in the sky, but still temptingly close.

George decided that he was not stupid enough to let a gull trick him into falling off the bridge.

The gull slanted and slid sideways down a long invisible slope of air and squalled "Creee. Ha ha ha ha. Ha ha ha . . ." in a raucous gull laugh. George hoped he would come back and make friends, but he had never heard of anyone making friends with a gull. He climbed on toward the New Jersey shore, going up and down slopes of girders, found a steel ladder fastened to the side and climbed it straight up to a paint locker and a telephone. He dialed Rescue Squad, and asked for Judd Oslow.

"Chief, I'm tired of taking a vacation."

"This morning Ahmed reported you walked like a cripple. How late did you work last night?"

"Three thirty."

"Find any clues to Carl Hodges?"

"Not exactly." George looked at the far, high planes and helicopters buzzing through the blue sky. He did not feel like discussing the failure of last night.

"Where are you now?"

"In a painter's crow's nest on George Washington Bridge."

"Climbing George Washington Bridge is your idea of a rest?"

"It's away from people. I like climbing."

"O.K., your choice. You are near Presbyterian Medical Center. Report to the Rescue Squad station



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there and fill out some reports on what you've been doing all week. Some of the things you've been doing, we would probably like to pay you for. The information girl there will help you fill out the forms. You'll like her, George. She doesn't mind paper work. Let her help you."

Ahmed Kosavakats, George's superior and childhood friend, was ready to admit defeat. He had reasoned in trying to find Carl Hodges and reasoned well.

Any commune which had Carl Hodges could ask him how to bias the city services computer in their favor. Ahmed had been checking the routine deliveries of repairs and improvements and rebuilding and projects to each commune, by running a comparison check against the normal deliveries through the statistics computer. Negative. There was no sign of a brilliant manipulator changing the city services.

Ahmed stood up and stretched long arms, thinking. Whoever had Carl Hodges was not using him. If Ahmed could rescue Carl Hodges and become his friend, he would not miss the opportunity to use him. If a man wanted to influence the future of his city . . .

If he could not use his own logic to find Carl Hodges, then the kidnappers were not thinking logically, and could not be predicted by logic. If they were thinking emotionally, then George Sanford could probably tune to them and locate them. But Ahmed would have to tell him what kind of people to tune to, and how they felt.

George Sanford's intuition was a reliable talent. Once, when George was a fattish, obliging kid in Ahmed's gang, Ahmed had added up how often George's simple remarks and guesses had turned out right. George had guessed right every time. But George didn't think. Half envious, Ahmed had told the others that George's head was like a radio, you could tune his brain to any station and get the news and weather and the right time in Paris, San Francisco, and Hong Kong, but a radio isn't going to add anything up, not even two plus two, it works because it's empty.

George Sanford had grown up to a big silent cat of a man. Extremely strong, not caring apparently whether he ate, drank, or slept, a rather blank expression, but he still tuned in on people. His goals were the simple ones of being with friends, helping out, and being welcome, and he had friends everywhere.

Behind the apparent low IQ there were untapped abilities that could only be brought into action by demanding a lot of George when you asked him to help. It was not certain yet how much George could do. George did not know. He probably did not even think about it. He had no demands on himself.

The thing to do, Ahmed



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thought, was to keep the pressure on George. Keep him working.

Ahmed found George filling out reports by dictating them to a pretty girl. The pretty office worker had her hands poised over the typewriter and was listening to George with an expression of surprise and doubt. George, with his brow knotted, was plodding through a narrative of something he had done the day before. The girl rolled the report sheet through the typewriter opposite a different blank and asked a question timidly, a tape recorder showed its red light, recording the questions and answers. George hesitated, looking at the ceiling desperately for inspiration, his brow more knotted than before.

George always had trouble understanding the reasoning behind red tape. He did not know why certain answers were wanted. They both looked up with relief when Ahmed interrupted by turning off the tape recorder.

"They told me to team up with you this afternoon," Ahmed said to George. "They give this job priority over reports or any other job. Are you feeling O.K. now?"

"Sure, Ahmed," George said, slightly surprised.

"Let's go outside and see if we can tune to the subject. O.K.?"

"O.K.," George got up, moving easily. A bruise showed at his hairline on the side of his head, almost hidden by hair. On George's right arm were two blue bruises, and below his slacks on the right ankle was a line of red dents with bruises. A left-handed assailant with a club, or a right-handed assailant with a chain, swinging it left to right, would bruise a man on one side like that.

Walking out of the Rescue Squad office Ahmed indicated with a gesture the bruise on George's arm.

"May I ask?"

"No," George replied and closed his mouth tightly, staring straight ahead as they went through the double doors.

George didn't want to talk about it, Ahmed thought, because he had lost that fight. That meant he had been outnumbered. But he was not dead or seriously hurt. The assailants then were not killers, or he had escaped them. Probably a trespassing problem. Probably George had trespassed onto some group's territory or kingdom last night while searching for Carl Hodges by himself. Ahmed put the thought aside. They stopped on a walk among the bushes and trees and looked up at the towering buildings of Presbyterian Medical Center, like giant walls reaching to the sky. Helicopter ambulances buzzed around landing steps like flies.

"Let's not waste time, George, let's get you tuned into Carl Hodges," Ahmed said, pulling out a notebook and pen. "Do you have a



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picture of Hodges with you?"

"No," The big young man looked uneasy. "You going to do it that same way, Ahmed? If he's sick, will I get sick?"

"I've got a picture here." Ahmed reached for a folder in his pocket and passed a photo to George.

The ground jolted in a sort of thud that struck upward against their feet.

Nine miles or more away, and two minutes earlier, Brooklyn Dome, the undersea suburb, suddenly lost its dome. The heavy ocean descended upon it, and air carrying a torrent of debris that had been houses and people blurted upward through an air shaft. A fountain of wreckage flung upward into the sky, falling in a circular rain of shattered parts to float upon the sea.

All morning a mass wish to escape from the enclosure of walls had driven George happily into the heights and winds and free sky. Now that note in the blend of the mood of the city suddenly changed and worsened to panic, helplessness, defeat, and pain, and then an end. The event telescoped in speed, compressed into a blow of darkness. The broadcast of many thousand minds ended and their background hum in the vibes of the city diminished.

Reaching out with his mind for information, George encountered the memory of that impact. It went by like the thunder wave of breaking the sound barrier, like a wave of black fog. He shut his eyes to tune in, and found nothing, except that the world had lightened. A burden of fear had been suddenly erased.

George opened his eyes and took a deep breath. "Something big," he said, "Something . . ."

Ahmed was watching the sweep second hand on his watch. "Fifty-five hundred feet, one mile," he muttered.

"What are you doing?"

"It's an explosion somewhere. I'm counting the distance. Sound arrives first through the ground, second through the air. I'm waiting for the sound. I'll get the distance by the time lag."

At thirty seconds the sound of the death of an underseas city reached them, a strange sort of grinding roar, muffled, low and distant.

George shut his eyes again, and felt the world change around him to another place.

"Got something, George?" Ahmed asked alertly. "That was about seven miles."

"Someone knows what happened. I'm picking him up. Brooklyn Dome just collapsed."

"Twelve thousand inhabitants," Ahmed said, dialing his wrist-radio grimly, his earphone plugged into his ear. "No one answering at headquarters, just busy signals."

George shut his eyes again, exploring the other place. "Someone's



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having a nightmare," he said. "He can't wake up."

"Don't flip out, George, keep in touch with facts. A lot of people just died, is all. Keep a grip on that. I'm trying to get our orders."

George stood with his eyes shut, exploring the sensation inside his head. Somewhere a man was trapped in a nightmare, half asleep in a dark prison or closet. It was some kind of delirium.

The real world was a cruel place that bright day, but the black and coiling fragments of that man's world were worse. There was something important about the man's thoughts. He had felt the explosion thud at a distance, as they had, and he had known what it meant. He had expected it.

"Can't locate where he is," George said, opening his eyes and regaining his grip on the bright sunshine world around him.

*Ahmed squinted and tilted his* head, listening to the obscure and rapid voices on the earplugs of his radio.

"Never mind about that case, George. That's Carl Hodges probably. He'll keep. Headquarters is broadcasting general orders for the emergency. Repair and services inspection people are ordered to make quick inspections at all danger points in the automatic services, looking for malfunction and sabotage. Repair and inspection teams are ordered into Jersey Dome, to check out every part of it and make sure it is not gimmicked to blow the way Brooklyn Dome went. They are instructed to describe it as a routine safety check."

"What do we do? What about us?"

"Wait, I'm listening. They mentioned us by name. We go to Jersey underseas and try to locate and stop a sabotage agent who might have sabotaged Brooklyn Dome and might be preparing to use the same method on Jersey Dome."

"What method?"

"They don't know. They don't even know if there is a saboteur. They're sending us to make sure."

"If there is a saboteur, he's probably working on it right now." George walked, and then ran for the subway steps down into the underground moving chair belts. Ahmed followed and they caught a brace of abandoned chairs just as they slowed and accelerated them *again out into the fast lanes.*

"Dirty dogs! Let me out of here. I'll kill you." Furiously Carl Hodges kicked and thrashed and bit at restraining straps, remembering at last, believing his conclusions about the group of teeners that had him prisoner. "You decerebrate lizards. Let me out of here, you fools! You killed Brooklyn Dome. I've got to get back to work and level off the exchanges before something else happens. Let me out of here!"

They backed off, their smiles fading at the barrage of his anger.



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The tallest one answered with a trace of resentment. "Don't get upset, Pops. They weren't real people, just technocrats and objectivists and fascists like that."

"They were techs. This city needs techs. People with tech jobs run the city, remember?"

The tall one leaned over him glowering. "I remember what my tapes tell me. The objectivists passed the law that the compulsory sterility of women can't be reversed without paying five hundred dollars for the operation. That means if I ever want to get married I'll have to save five hundred dollars for my woman to have a kid. They're trying to wipe us all out. Nobody has that kind of money but techs. In the next generation we'll all be gone. We're just getting back at them, wiping them out."

"But faster," chuckled a small kid. "Like *boom*!"

"The objectivists got that law through legally, why don't your people pull enough votes to get it wiped?" Carl Hodges demanded.

"They ship us out to the boondocks. We can't vote. You're talking like an objectivist. Maybe you believe everyone without money should be wiped?"

"I believe anyone without brains should be wiped!" Carl Hodges snarled suddenly. "Your mothers wouldn't have paid ten cents to have you. Too bad the law wasn't passed sooner."

"Genocide." The tall one reached over and hit him across the mouth. "We were nice to you. To *you*!" He turned and spat in revulsion.

Others surged forward.

"Steady," the leader spread arms and leaned back against the pressure. He addressed Carl. "We don't want to hurt you. You tell us things, you're a good teacher. We'll let you have what you want. Money for rights. Lie there until you have enough money to buy your way out. It will cost you five dollars to get out. That's cheaper than five hundred dollars to be born. That's a bargain."

The kids crowding behind him laughed, and laughed again understanding the idea slowly. After a time of clumsy humor they untied him and went off, leaving him locked in a narrow windowless bedroom.

Carl Hodges went around the room, inspecting it and thinking coldly of escaping. He had to get out and straighten up the mess the city was in after the collapse of Brooklyn Dome. He had to get out and have the kids arrested before they sabotaged anything else. According to his best logic, there was no way to get out. He was stuck, and deserved it. He pushed his mind, thinking harder, fighting back a return of weakness and tears. He reached for a happy pill, then took the bottle of white pills and poured its contents down a hole in the floor.



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The two Resque Squad men shifted their chairs through acceleration bands to the inner fast slots, and passed the other chairs, each leaning forward on the safety rail of his chairs as if urging it on. The people they passed were holding portable TV screens like magazines, watching in the same way that people used to read.

The voice of the announcer murmured from a screen, grew louder as they passed, and then again fell to a murmur. "Brooklyn Dome. Fifteen pounds atmosphere pressure to sixty-five pounds per square inch. Exploded upward. Implosion first, then explosion." The voice grew louder again as they approached another sliding chair in the slower lane. Another person listened, propping the screen up on the safety rail to stare into it, with the sound shouting. "Debris is floating for two square miles around the center from which the explosion came. Coast Guard rescue ships, submarines and scuba divers are converged into the area, searching for survivors."

"This is the way the explosion looked from the deck of a freighter, the *Mary-Lou*, five miles south at the moment it occurred." They neared and passed a TV screen which showed a distant picture of an explosion like an umbrella rising and opening on the horizon.

George settled himself in his seat and shut his eyes to concentrate. He had to stop that explosion from happening again to the other undersea dome. Whoever had done it would be laughing as he watched on TV the explosion unfold and settle. Whoever had done it would be eager for destruction, delighting in the death and blood of a small city.

The peculiarly wide range of perceptions that was George Sanford groped out across the city.

"The police department is still investigating the cause of the explosion," said the murmur, growing louder as they passed another TV watcher in the slow lane. Someone handed the announcer another note. "Ah, here we have some new information. Bell Telephone has opened up to the investigators eight recordings taken from public phones in Brooklyn Dome. These phone calls were being made at the moment Brooklyn Dome was destroyed."

A face appeared on a screen behind the announcer, a giant face of a woman telephoning. After an instant of mental adjusting of viewpoint the woman's face became normal in the viewer eye, the announcer shrank to ant size and was forgotten as the woman spoke rapidly into the phone. "I can't stand this place another minute. I would have left already, but I can't leave. The train station is jammed and there are lines in front of the ticket booth. I've never seen such lines. Jerry is getting tickets. I wish he'd



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hurry." The anxious woman's face glanced sideways either way out of the booth. "I hear the funniest noise, like thunder. Like a waterfall."

The woman screamed and the background tilted as the screaming face and the booth went over sideways. A hand groped past the lens, blackness entered in sheets, and the picture broke into static sparks and splashes. The screen went blank, the antlike announcer sitting in front of it spoke soothingly and the camera rushed forward to him until he was normal size again. He showed a diagram.

George opened his eyes and sat up. Around him on the moving chairs people were watching their TV screens show the pictures he had just seen in his mind's eyes. It showed a diagram of the location of the phone booths at Brooklyn Dome, and then another recording of someone innocently calling from a videophone booth, about to die, and not knowing what was about to happen, an innocent middle-aged face.

Expressionlessly, the people in the traveling subway seats watched, hands bracing the sides of the TV screen, grip tightening as they waited for the ceilings to fall. Audience anticipation; love of power, greatness, crash . . . total force and completeness . . . admiring triumph of completeness in such destruction. Great show. Hope for more horror.

All over the city people looked at the innocent fool mouthing words and they waited, watching, urging the doom on as it approached. *This time be bigger, blacker, more frightening, more crushing.*

George shut his eyes and waited through the hoarse screams and then opened his eyes and looked at the back of the neck of the TV watcher they were passing, then turned around and looked at her face after they passed. She did not notice him, she was watching the TV intently, without outward expression.

Did that woman admit the delight she felt? Did she know she was urging the thundering waterfall on, striking the deathblow downward with the descending ocean? She was not different from the others. Typical television viewer, lover of extremes. It was to her credit that when TV showed young lovers she urged them to love more intensely, and rejoiced in their kisses. Lovers of life are also lovers of death.

George slid down furthur in his seat and closed his eyes, and rode the tidal waves of mass emotion as the millions of watchers, emotions synchronized by watching, enjoyed their mass participation in the death rites of a small city. Over and over, expectancy, anticipation, panic, defeat, death, satisfaction.

The secretly-worshiped god of death rode high.



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In twenty minutes, after transfers on platforms that held air-lock doors to pass through into denser air, they arrived, carried by underseas tube train, at the small undersea city of Jersey Dome. Population: ten thousand; residents: Civil Service administrators and their families.

The city manager's office building was built of large colored blocks of lightweight translucent foam plastic, like children's large building blocks. There was no wind to blow it away. Inside, the colors of the light tinted the city man's desk. He was a small man sitting behind a large desk with one phone held to his ear and another blinking a red light at him, untouched. "I know traffic is piling up. We have all the trains in service that city services can give up. Everyone wants to leave, that's all. No. There isn't any panic. There's no reason for panic." He hung up, and glared at the other phone's blinking light.

"That phone," he snarled, pointing, "is an outside line full of idiot reporters asking me how domes are built and how Brooklyn Dome could have blown up, or collapsed. It's all idiocy. Well. What do you want?"

Ahmed opened his wallet to his credentials and handed it over. "We're from Metropolitan Rescue Squad. We're specialists in locating people by predicting behavior. We were sent over to locate a possible lunatic who might have sabotaged Brooklyn Dome or blown it up, and might be here planning to blow up Jersey Dome."

"He just might," replied the manager of Jersey Dome with a high-pitched trembling earnestness in his voice. "And you might be the only dangerous lunatics around here. Lunatics who talk about Jersey Dome breaking. It can't break. You understand. The only thing we have to fear is panic. You understand?"

"Of course," Ahmed said soothingly. "But we won't talk about it breaking. It's our job to look for a saboteur. Probably it's just a routine preventative checkup."

The manager pulled a pistol out of a desk drawer and pointed it at them, with a trembling hand. "You're still talking about it. This is an emergency. I am the city manager. I could call my police and have you taken to a mental hospital, gagged."

"Don't worry about that," Ahmed said soothingly, picking his wallet back off the desk and pocketing it. "We're only here to admire the design and the machinery. Can we have a map?"

The manager lowered the pistol and laid it on the desk. "If you cooperate, the girl in the front office will give you all the maps of the design and structure that you'll need. You will find a lot of technicians already in the works, inspecting wires and checking up.



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They're here to design improvements. You understand?" His voice was still high-pitched and nervous, but steady.

"We understand," Ahmed assured him. "Everything is perfectly safe. We'll go admire their designs and improvements. Come on, George." He turned and went out, stopped at the receptionist's desk to get a map, consulted it and led the way across the trimmed lawn of the park.

Out on the curved walk under the innocent blue-green glow of the dome, Ahmed glanced back. "But I'm not sure he's perfectly safe himself. Is he cracking up, George?"

"Not yet, but near it." George glanced up apprehensively at the blue-green glow, imagining he saw a rift, but the dark streak was only a catwalk, near the dome surface.

"What will he do when he cracks?" asked Ahmed.

"Run around screaming 'The sky is falling!' like Chicken Little," muttered George, "What else?" He cocked an apprehensive glance upward at the green glow of the dome. Was it sagging in the middle? No, that was just an effect of perspective. Was there a crack appearing near the air shaft? No, just another catwalk, like a spiderweb on a ceiling.

Making an effort he pulled his eyes away from the dome and saw Ahmed at a small building ahead labeled "Power Substation 10002." It looked like a child's building block ten feet high, pleasantly screened by bushes, matching the park. Ahmed was looking in the open door. He signaled to George and George hurried to reach him, feeling as if the pressurized thickened air resisted, like water.

He looked inside and saw a man inside tinkering with the heavy power cables that provided light and power for the undersea dome. Panels were off, and the connections were exposed.

The actions and mood of the man were those of a workman, serious and careful. He set a meter dial and carefully read it, reset it and made notes, then read it again. George watched him. There was a strange kind of fear in the man, something worse than the boxed-in feeling of being underwater. George felt a similar apprehension. It had been growing in him. He looked at Ahmed, doubtfully.

Ahmed had been lounging against the open door watching George and the man. He took a deep sighing breath and went in with weight evenly balanced on his feet, ready for fast action. "O.K., how are the improvements coming?" he asked the workman.

The man grinned over his shoulder. He was slightly bald in front. "Not a single improvement, not even a small bomb."

"Let's check your ID. We're looking for the saboteur." Ahmed held out his hand.



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Obligingly the man unpinned a plastic ID card from under his lapel, and put a thumbprint over the photographed thumbprint so that it could be seen that the two prints matched. He seemed unafraid of them, and friendly.

"O.K." Ahmed passed his badge back.

The engineer pinned it back on. "Have fun, detectives. I hope you nail a mad bomber so we can stop checking for defects and go home. I can't stand this air down here. Crazy perfume. I don't like it."

"Me, too," George said. A thick perfumed pressure was in the air. He felt the weight of water hanging as a dome far above the city pressing the air down. "Bad air."

"It has helium in it," Ahmed remarked. He checked the map of the small city and looked in the direction of a glittering glass elevator shaft. A metal mesh elevator rose slowly in the shaft, shining in the semidark, like a giant birdcage full of people hanging above a giant living room.

George tried to take another deep breath and felt that whatever he was breathing was not air. "It smells strange, like fake air."

"It doesn't matter how it smells," Ahmed said, leading the way. "It's to keep people from getting the bends from internal pressure when they leave here. Why didn't you O.K. the man, George? His ID checked out."

"He was scared."

"What of?" Ahmed asked him.

"Not of us. I don't know."

"Then it doesn't matter. He's not up to any bad business."

The two walked across the small green park, through the thick air, toward the glittering glass shaft that went up from the ground into the distant green dome that was the roof of the city. Inside the huge glass tube a brightly lit elevator rose slowly, carrying a crowd of people looking out over the city as a canary would look out above a giant room.

"Next we check the air-pump controls," Ahmed said. "They're near the elevator." People went by, looking formal and overdressed, pale and quiet, stiff and neat. Not his kind of people. Civil servants, government administration people, accountants.

George followed, trying to breathe. The air seemed to be not air, but some inferior substitute. Glittering small buildings rose on either side of the park in rows, like teeth, and he felt inside a tiger mouth. The air smelled like lilies in a funeral parlor. The people he passed gave out vibes of a trapped hopeless defeat that made his depression worse. They passed a crowd of quiet miserable people waiting to get on the elevator, carrying fishing poles and swimming equipment.

High above them the elevator descended slowly.

"That's bad," George said. "You feel it, don't you, Ahmed?"



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"Feel what?" Ahmed stopped beside a small rounded building attached to the side of the shaft. The building throbbed with a deep steady *thump, thump, thump,* like a giant heart.

"I want to get out of here," George said. "Don't you feel it?"

"I ignore that kind of feeling," Ahmed said expressionlessly, and pulled on the handle of the door to the pump room. It was unlocked. It opened. The thumping was louder. "Should be locked," Ahmed muttered. They looked inside.

Inside, down a flight of steps two workmen were checking over some large warm thumping machinery. The two detectives went down the steps.

"Identity check, let's see your ID," George said, and looked at the two badges they handed him, in the same way he had seen Ahmed and other detectives checking them over. He took thumbprints and matched them to the photo thumbprints, he compared the faces on the photos to the faces before him. One big one with a craggy, stone chiseled face and vertical grim lines on the cheeks; one short weathered one, slightly leaner, slightly more humor in the face. Both identified as engineers of Consolidated Power and Light, inspectors of electrical motor appliance and life support services.

"What are the pumps doing?" Ahmed asked, looking around.

"Pumping air in, pumping water out," replied one of the men. "There's the pump that pushes excess water up to the top where it comes out as a little ornamental fountain in an artificial island. The pressure equalizes by itself, so it doesn't need elaborate equipment, just power."

"Why pump water out?" Ahmed asked. "The air pressure is supposed to be so high that it pushes the water out."

The man laughed. "You make it sound so simple. The air pressure is approximately the same here as up at the top surface of the dome, but the water pressure rises every foot of the way down. Down here at the bottom it is higher than the air pressure. Water squeezes in along the edges of the cement slab, up through the ground cover and the dirt. We have drains to catch the seepage and lead it back to this pump. We expect seepage."

"Why not pump in more air? Higher air pressure would keep all the water out."

"Higher air pressure would burst the top of the dome like a balloon. There isn't enough weight of water to counterpush."

George got an uncertain picture of air pushing to get out the top and water pushing to get in the bottom. "It's working all right?" He handed the ID badges back to them.

"Right," said the explanatory man, pinning on his badge. "It



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would take a bomb to get those pumps out of balance. Don't know why they sent us to check the pumps. I'd rather be out fishing."

"They're looking for a bomb, dummy," said the other one sourly.

"Oh." The bigger one made a face. "You mean, like Brooklyn Dome blew up?" He looked around slowly. "If anything starts to happen, we're right near the elevator. We can get to the top."

"Not a chance," said the sour one. "The elevator is too slow. And it has a waiting line, people ahead of you. Resign yourself. If this place blows, we blow."

"Why is the elevator so slow?" George asked. *Fix it!* He hoped silently. They listened to the hum of the elevator engine lowering the elevator. It was slow.

"It can go faster, the timer's right here." The sour engineer walked over and inspected the box. "Someone has set it to the slowest speed. I wonder why?"

"For sightseeing." George said, "But I saw the crowd waiting. They have fishpoles. They want to get to the top, they don't want to wait in the middle of the air, just viewing."

"O.K.," the big talkative one walked over and firmly set the pointer over to "fast." The sound of the elevator reached the ground on the other side of the wall, rumbled to a stop, and the doors whirred open.

They listened, hearing voices and the shuffle of feet as people crowded into the elevator, then the doors rumbled shut and the elevator started for the top. The whirr was high and rapid. In less than a third the time the trip up to the surface had taken before, the whirr stopped.

The two engineers nodded at each other. "I hope they are happy with it."

"They are getting there faster." George said, "That makes sense," and Ahmed nodded agreement. They went out and watched the elevator return. As rapidly as falling, the great silver bird cage came down the glass shaft and slowed, and stopped, and opened. It was empty. No one who was up there was coming back in to the city.

More people got on.

"What is up there?" George asked holding himself back from a panic desire to get in the elevator with the others and get out of the enclosed city. "I have a feeling we should go up there," he said, hoping Ahmed would misunderstand and think George was being called by a hunch.

"What do you feel?" Ahmed looked at him keenly. The doors of the elevator shut and the elevator rose rapidly, leaving them behind on the ground.

"What I feel is, we shouldn't have let that elevator go without us. We've had it, old buddy. It's



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been nice knowing you. I didn't expect to die young."

"Snap out of it," Ahmed clicked his fingers under George's nose. "You're talking for somebody else. Hold that feeling separate from your thinking. It's not your kind of feeling. George Sanford isn't afraid, ever. You don't think like that."

"Yes, I do," George said sadly. He heard the elevator doors rumble open far overhead. Somewhere above people had escaped to the top of the ocean instead of the bottom. A dock? An island? Somewhere fresh winds were blowing across ocean waves.

"Locate that feeling of doom," Ahmed said. "Maybe our mad bomber is a suicider and plans to go down with the ship. Shut your eyes. Where are you in your head?"

"On top, on an island in the daylight," George said sadly, looking at his imagination of sand and seagulls. "It's too late, Ahmed. We're dead." A few new people arrived and lined up behind him waiting for the elevator. The sound of the elevator began far above. People approached through the park from the direction of the railway station, and George remembered that there had been fenced in crowds waiting for trains, waiting to get out. Maybe some people had grown impatient and wanted to get to fresh air. The crowd behind him grew denser and began to push. The elevator doors opened in front of George.

"Get in, George," said Ahmed, and pushed his elbow. "We're going to the top."

"Thanks," George got on. They were pushed to the back of the cage and the doors shut and the elevator rose with knee-pressing speed. Over the heads of the people before him George saw a widening vision of the undersea city, small buildings circling a central park, dimly and artistically lit by green and blue spotlights on trees and vines, with a rippling effect in the light like seaweed and underwater waves. Paths and roads were lit with bead chains of golden sodium lights. On the other side of the park the railroad station, squares of soft yellow light, fenced in by lacework metal walls. Many people around it. Too many. Dense crowds. The paths across the park were moving with people approaching the elevator shaft.

The elevator reached the top of the dome and went through into a tube of darkness. For a few moments they rose through darkness and then they felt the elevator slow and stop. The doors rumbled open and the people pressed out, hurried through a glass door and down a staircase, and were gone from the top floor.

George looked around. There was the sky and ocean spaces he had dreamed of, but the sky was cloudy, the ocean was gray, and he was looking at them through thick



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glass. The island viewing platform was arranged in a series of giant glass steps, and the elevator had opened and let them into the top step, a glass room that looked out in all directions through thick glass, giving a clear view of the horizon, the glass rooms below, and the little motor boats that circled the docks of an artificial island.

"How's your hunch? What do you feel?" Ahmed snapped out, looking around alertly, weight on the balls of his feet, ready to spring at some mad bomber that he expected George to locate.

"The air is faked. I can't breathe it." George said, breathing noisily through his mouth. He felt like crying. This was not the escape he had dreamed of. The feeling of doom persisted and grew worse.

"It's the same air and the same pressure as down undersea in the dome," Ahmed said impatiently. "They keep the pressure high so people can come here from under without going through air locks. They can look, take pictures and go back down. It smells lousy, so ignore it."

"You mean the air is under pressure here, as bad as all the way down at the bottom of the ocean?"

"Yes, lunk. That's what makes sense to them, so that's the way they have it set up."

"That's why the wall is so thick then, so it won't burst, and let the pressure out," George said, feeling as if the thickness of the wall were a deliberate coffin wall, keeping him from escaping. He looked out through the thick glass wall and down through the glass roof of the observation room that was the next step down. He saw chairs and magazines like a waiting room, and the crowd of people that had come on the elevator with him, lined up at a glass door, with the first one in line tugging at the handle of the door. The door was not opening. "What are they doing?"

"They are waiting for the air pressure in the room to go down and equalize with the air pressure in the stairwell and the next room. Right now the pressure in the room presses the door shut. It opens inward as soon as the pressure goes down." Ahmed looked bored.

"We have to go out." George strode over to the inside door that shut off a stair leading down to the next room. He tugged. The glass door did not open. "Air pressure?"

"Yes, wait, the elevator is rising. It seems to be compressing the air, forcing it upward." Thick air made Ahmed's voice high-pitched and distant.

George tugged on the handle, feeling the air growing thicker and press on his eardrums. "We have enough pressure here already. We don't need any more fake air. Just some real air. I want to be out of here."

The elevator door opened and a group of people, some carrying



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suitcases, some carrying fishing gear, pressed out and milled and lined up at the door behind George, pushing each other and murmuring complaints about pushing in tones that were much less subdued than the civil service culture usually considered to be polite.

The elevator closed its doors and sank out of sight, and air pressure began to drop as if the air followed the piston of the elevator in pumping up and down. George swallowed and his eardrums clicked and rang. He yanked hard on the handle of the stairwell door. It swung wide with a hiss and he held it open. The crowd hurried down the stairs, giving him polite thanks as they passed. With each thanks received he felt the fear of the person passing. He stared into the faces of a woman, a teener, a young woman, a handsome middle-aged man, looking for something beside fear, and finding only fear and a mouselike instinctive urge to escape a trap, and a fear of fear that kept them quiet, afraid to express the sense of disaster that filled their imaginations.

"Argh," said George as the last one went down the stair. "Hurry up, Ahmed, maybe they are right." He gestured his friend through the door and ran down after him onto the lower step of a big glass-viewing room with tables and magazines to make waiting easy. Behind him he heard the door lock shut and the whirr of the elevator returning to the top with more people.

George leaned his forehead against the thick glass walls and looked out at a scene of little docks and a buzz of small electric boats circling the platform, bouncing in a gray choppy sea, under thick gray clouds.

"What's out there?" Ahmed asked.

"Escape."

"What about the saboteur?" Ahmed asked with an edge of impatience. "What is he thinking, or feeling? Are you picking anything up?"

"One of those boats is it," George answered, lying to avoid Ahmed's duty to return to the undersea city. "Or a small submarine, right out there. The top's going to be blasted off the observation platform. Get rescue boats in here. Use your radio, hurry, and get me a helicopter. I want to be in the air to spot which boat."

It wasn't all lies, some of it felt like the truth. He still leaned his forehead against the wall and looked out, knowing he would say anything to get out. Or do anything. He tried to tune to the idea of sabotage, and open to other people's thoughts but the urge to escape came back in a greater sickness and swamped other thoughts. *"Why?"* he asked the fear. *"What is going to happen?"* An image came of horses kicking down a barn



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from inside, of cattle stampeding, of a chick pecking to get out of an egg, with the chick an embryo, not ready yet to survive in air. Kicking skeleton feet broke through from inside a bubble and the bubble vanished. The images were confusing. He looked away from his thoughts and watched the outside platform.

The platform was crowded with people, shivering in a cold wind, apparently waiting their turn to enjoy a ride in the little boats. George knew that they were outdoors because they could not stand being indoors.

Ahmed tapped on his arm. He had the wrist-radio earphones plugged into both ears, and his voice sounded odd and deaf. "Headquarters wants to know why, George. Can you give details?"

"Tell them they have five minutes, seven minutes if they're lucky. Get the patrol boats here to stop it and"—George almost shouted into Ahmed's wrist mike—"GET ME THAT HELICOPTER. Get it over here fast! We need it as soon as we get through the air locks!"

The glass air-lock door opened and people tumbled and shoved through. On the other side was another room surrounded by glass. They lined up against the glass walls like moths against a lighted windowpane, looking out.

"Why do we have to wait so long?" It was a wail, a crying sound like an ambulance siren in the night. The group muttered agreement and nodded at the woman who clutched her hands against the glass as though trying to touch the scene outside.

"I'm not worried about the bends," said a portly older man. "They adjust the waiting time for people with bad sinus and eardrum infections. Does anyone here have a sinus, or eardrum infection?"

"We don't need to wait then," said the same man louder when there was no reply. "Does anyone here know how to make the door open? We can go out right now."

"My son has a screwdriver," suggested a woman, pushing the teen-age young man toward the door. Ahmed moved to protest and the woman glared at him and opened her mouth to argue.

An old woman was tugging at the door. It opened suddenly and they forgot quarreling and went out through the door to the open docks and the cold salt wind, and the sound of cold choppy waves splashing against the cement pillars.

An air-beating heavy whirring sound hovered above the docks.

Ahmed looked up. A ladder fell down and dangled before them. Ahmed grabbed the rope rungs and pulled. They sagged lower. He fitted his foot into a rung and climbed.

George stood, breathing deeply of an air that smelled sweet and right and tingled in his lungs like life and energy. The clouds of



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panic and resignation faded from his mind and he heard the seagulls screaming raucous delight, following the small boats and swooping at sandwiches. The people clustered at the edge of the docks, beginning to talk in normal tones.

The ladder dangled before him, bobbing up and down. The rope rungs brushed against his head and he brushed them aside. What had been happening? What was the doom he had just escaped from? He tried to remember the trapped moments and tried to understand what they had been.

"Come on, George," a voice called from above.

He reached up, gripped and climbed, looking up into a sky of scudding gray and silver clouds, and a white and blue police helicopter, bouncing above him, its rotating wings shoved damp fresh cool air against him in a kind of pressure that he enjoyed fighting. At the top the ladder stiffened into a metal stair with rails, and opened into the carpeted glass-walled platform of a big observation helicopter.

Ahmed sat cross-legged on the floor, twitching with hurry and impatience, holding his wrist radio to his lips. "O.K., George tune to it. *What* will blow the observation building? Who, what, where? Coast Guard is waiting for information."

Still with his memory gripped onto the strange depression he had felt inside the observation building, in the air of Jersey Dome, George looked down and tuned to it and knew how the people still inside felt, and what they wanted.

In the four-step glittering observation building, each glass room was full of people waiting at the doors. He saw the central elevator arrive and open its door and let out another crowd of people to wait and push and pull at the first door at the top. Desperation. A need to get out.

With a feeling of great sorrow, George knew who the saboteurs were. All the kids with screwdrivers, all the helpful people with technical skill who speed elevators, all the helpful people without mechanical understanding who would prop open dime-operated toilet doors for the stranger in need. They were going to be helpful, they were going to go through the air-lock doors and leave the doors jammed open behind them. No resistance behind them to hold back sixty-five pounds per square inch air pressure forcing up from below in the compressed city, pushing upward behind the rising elevator.

He had been pretending to believe it was a mad bomber. How could he tell the police and Coast Guard that it was just the residents of the city, mindless with the need to get out, destroying their own air-lock system?

George held his head, the vision of death strong and blinding. "They are jamming the air-lock



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system open in the observation building Ahmed, tell someone to stop them. They can't do that. It will blow!" The panic need to escape blanked his mind again.

"Lift," George said, making nervous faces at the view below. "Lift this damned copter."

"Is he all right?" the pilot asked Ahmed.

Ahmed was talking intensely into the wrist radio, repeating and relaying George's message. He made a chopping gesture to shut up.

The copter pilot gave them both a glance that doubted their sanity and set the copter to lift, very slowly.

Slowly beating the air, the copter rose, tilting, and lifted away from the dwindling platform of glinting glass in the middle of the gray ocean.

George gripped the observation rail and watched, ashamed that his hands were shaking.

He saw something indefinable and peculiar begin to happen to the shape of the glass building. "There it goes," he muttered and abruptly sat down on the floor and put his hands over his face. "Hang on to the controls. Here we go. Ahmed, you look. Take pictures or something."

There was a crash, and a boom like a cannon. Something that looked like a crushed elevator full of people shot upward at them, passed them slowly, and then fell, tumbling over and over downward.

A roaring uprush of air grabbed the copter and carried it into the sky, the plane tilted sideways and began to fall sideways. For a moment it was upside down, falling in a rain of small objects that looked like briefcases and fishing rods and small broken pieces that could not be recognized. George hung on to a railing to keep from falling, then suddenly the copter was right side up, beating its heavy spinning wings in a straining pull upward away from the rising tornado that tried to tilt it over again.

With a tearing roar Jersey Dome spat its contents upward through the air shaft, squeezing buildings and foam blocks and people and furniture into the shaft and upward in a hose of air, upward to the surface and higher in a fountain of debris, to fall back, mangled by explosive decompression to the surface of the ocean.

For a long moment the fountain of air was a mushroom-shaped cloud of debris, then it subsided.

With one arm and leg still hooked around the rail, Ahmed listened intently to his radio, hands cupped over his ears to make the speaker plugs in his ears louder. He spoke.

"The city manager is alive down there and broadcasting. He says the canopy of the dome did not break, it just lowered. The air shaft sucked in everything near it and is now plugged shut with foam blocks from buildings but the blocks are



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slowly compressing into it, and they can hear an air hiss. Survivors are putting on scuba air equipment and finding places to survive another hurricane if the tube blows free again, but he's afraid of water leaks coming in and drowning them out from underneath because the pressure is going down. He wants the air shaft plugged from the top. Suggests bombing it at the top to prevent more air escaping.

Ahmed listened, tilting his head to the sounds in his ears.

"People in the water," George said. "Bombs make concussion. Let's get the people out."

"Affirmative," said the police pilot. "Look for people."

The helicopter swept low and cruised over the water, and they looked down at the close passing waves for a human swimmer needing help.

"There," Ahmed pointed at a pink shiny arm, a dark head. They circled back, and hovered, let down the ladder, and the two Rescue Squad men climbed down, and maneuvered a web mesh sling around a limp young unconscious naked woman. Her head bobbed under and came up as they slid the sling under her. The waves washed up against their knees as they leaned out from the rope ladder.

"NOW HEAR THIS, NOW HEAR THIS," proclaimed a giant amplifed voice. "ALL BOATS IN THE AREA CIRCLE IN THE DISASTER AREA AND TAKE IN SURVIVORS. IN FIVE MINUTES AT THE NEXT SIGNAL, ALL BOATS MUST WITHDRAW FROM THE AIR SHAFT CENTER TO A DISTANCE OF FIVE HUNDRED YARDS TO PERMIT BOMBING. AWAIT SIGNAL. REPEAT. YOU HAVE FIVE MINUTES TO SEARCH FOR AND TAKE IN SURVIVORS."

Ahmed and George shouted up to the pilot, "Ready." And the hoist drew the mesh sling with the young woman in it upward and into the copter through a cargo door in the bottom. The door hatch closed. They climbed back inside, dripping, and spread the unconscious and pretty body out on the floor for artificial respiration. She was cold, pulseless and bleeding from ears, nose, and closed eyes. There were no bruises or breaks visible on the smooth skin. George tried gentle hand pressure on the rib cage to start her breathing again, and some blood came from her mouth with a sigh. He pushed again. Blood came from her eyes like tears.

Ahmed said wearily. "Give it up, George, she's dead."

George stood up and retreated from the body, backing away. "What do we do, throw her back?"

"No, we have to take bodies to the hospital. Regulations," muttered the pilot.

They circled the copter around



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over the choppy gray seas, wipers going on the windshield. The body lay on the floor between them, touching their feet.

They saw an arm bobbing on the waves.

"Should we haul it in?" George asked.

"No, we don't have to take pieces," said the cop, tone level.

They circled on, passing the little electric boats of the people who had been fishing when the dome blew. The faces were pale as they looked up at the passing helicopter.

The corpse lay on the floor between them, the body smooth and perfect. The plane tilted and the body rolled. The arms and legs moved.

Ahmed seated himself in the copilot's seat, fastened the safety harness and leaned forward with his head in his hands, not looking at the corpse. George looked out the windshields at the bobbing debris of furniture and unidentifiable bits, and watched Coast Guard boats approaching and searching the water.

The copter radio beeped urgently. The pilot switched it on. "Coast Guard command to Police Helicopter PB 1005768. Thank you for your assistance, we now have enough Coast Guard ships and planes in the search pattern, please withdraw from the disaster area. Please withdraw from the disaster area."

"Order acknowledged. Withdrawing," the pilot said and switched the radio off. He changed the radio setting and spoke briefly to Rescue Squad Headquarters, and turned the plane away from the area of destruction and toward the distant shore.

"What's your job in police?" he asked over his shoulder.

George did not answer.

"Rescue, Detection, and Prevention," Ahmed answered for him. "We were in Jersey Dome ten minutes ago." Behind them the bombs boomed, breaking and closing the air shaft.

"You sure didn't prevent this one," said the copter pilot.

Ahmed did not answer.

"This is a blackmail tape. One copy of this tape has been mailed to each of the major communes and subcities in the New York City district.

"We are responsible for the destruction of Brooklyn Dome. It was a warning, and demonstrated our ability to destroy. We have in our possession a futures expert whose specialty was locating and predicting accidental dangers to the city complex caused by possible simple mechanical and human failures. He is drugged and cooperative. We asked him how Brooklyn Dome could self-destruct from a simple mechanical failure, and he explained how. We are now prepared to offer his services for sale. Our fee will be fifteen thousand



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dollars a question. If you are afraid that your commune has enemies, your logical question would be, what and who can destroy my commune, and how can I prevent this attack? We will provide the answer service to your enemies, if they pay. They might be asking how to destroy your commune as you listen to this tape. Remember Brooklyn Dome. The name and address enclosed is your personal contact with us. No one else has this name. Keep it secret from the police, and use it when you decide to pay. If you give your contact up to the police, you will cut yourself off from our advice, your enemies will contact us through other names, and buy methods to destroy you. Remember Brooklyn Dome. Act soon. Our fee is fifteen thousand dollars a question. The price of survival is cheap."

"Every police department has a copy. Want me to play it again?" Judd Oslow asked. He sat cross-legged on top of his desk like a large fat Buddha statue and sipped coffee.

"Once was enough," Ahmed said. "Paranoia, and war among the communes. What do those nuts think they are doing with that tape?"

"Making money." Judd Oslow sipped his coffee, carefully staying calm. "They mailed one to each commune in the city area, and only two have turned in the entire tape, or admitted receiving it. Only one has turned in his address. The other must be keeping their addresses, planning to ask attack, or defense, questions."

"Armageddon," said Ahmed.

Judd said, "George, why don't you get off your rump and bring in Carl Hodges? These nuts can't sell his brains if we get him back."

Ahmed said, "You just gave George the job last night. He almost had him this morning, but we were reassigned when Brooklyn Dome blew, and had to get off Carl Hodges's trail to go to Jersey Dome."

"So there's some of the day left. George has spoiled me with success. I'm used to instant results. Come on George, Carl Hodges, right here in this office, packaged and delivered."

George looked up at him, eyes round and puzzled. "I'm supposed to help people. Every time I start trying to help Carl Hodges something bad happens. It doesn't come out right. Maybe he likes being in trouble. Bodies all over the place! You don't want me helping, with my luck!"

"Snap out of it, George. This is no time for pessimistic philosophy. Get together with Ahmed and hypnotize yourself and tell me where Carl Hodges is."

"What's the use?" George ran his hands over his head in a weary gesture that was not one of his usual gestures. "Brooklyn Dome people are dead already. Jersey



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Dome people are mostly dead already. Everybody that ever died is still dead. Billions of people since the beginning of time. How are you going to rescue *them*? Why not let a few more die? What difference does it make?"

"Let's not have an essay on Eternity, George. Nothing makes any difference to Eternity. We don't live in Eternity, we live in now. We want Carl Hodges now."

"What's the use? My advice just makes trouble. I didn't save those people in Jersey Dome. I wasn't smart enough to understand that they'd want to break their own air locks. No it wasn't the panic, it was the depression. The air changed its charge. Lab animals act irrational when you reverse the ground to air static charge gradient. I should have . . ."

Judd shouted, "George, I'm not interested in your bad conscience. If you want to help people, just answer the question."

George winced at the loudness and squinted up at him with his eyes seeming crossed. "George?"

*"Wow!"* Ahmed stepped forward. "Wait a minute. George did it already. That was Carl answering you."

Judd hesitated between confident forward and back motions. He started and stopped a gesture. His confusion reached his expression. He shouted, "Get out of here, you kooks. Go do your lunacy somewhere else. When you bring back Carl Hodges, don't tell me how you did it."

"Affirmative," Ahmed said. "Come on, Carl."

In confusion and guilt George followed and found himself on the open sidewalk, standing under a row of maple trees. The wind blew and the trees shed a flutter of green winged seeds about him. He knew he had failed his job somehow, and couldn't figure out how to get back to it. He walked to a bench and sat down.

"Do you understand what was just happening?" Ahmed asked.

"Yes," he felt in his mind and found confusion. "No."

"Shut your eyes. You seem to be on a bench in a park. It is an illusion. This is not where you are. Where are you really?"

George had shut his eyes. The voice went in deeply into a place in his mind where he knew he was in a room, a prisoner, and it was his fault. He did not like that knowledge. Better to pretend. He opened his eyes. "I want to be here in the park. Pretend you are real." He bent and touched some green vetch at his feet and felt the tiny ferns. "History doesn't matter. Sensation matters," he said earnestly. "Even these illusions are real because they are happening now. We live in now. Memory isn't real. The past doesn't exist. Why should we feel anything about the past, or care about it?"



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Ahmed computed that it was a good probability that Carl Hodges was speaking through George and looking through his eyes as a form of escape. The rationalization was fluent, the vocabulary not George's. Vocabulary choice is as constant as fingerprints.

The person speaking had to be Carl Hodges.

"Carl Hodges. Do you want to get away from where you are and lie down in this park?"

"You are a questioner. I should not speak."

"Is it wrong to answer questions?"

"Yes, answers kill. People are dead. Like Susanne, they are all dead. Does mourning one person kill others? They drowned too, and floated. Saw girl in water . . . Connection . . . ?"

George had been speaking dreamily, eyes wide and round and sightless. He closed his eyes and every muscle in face and body tightened in a curling spasm like pain. He slid off the bench and fell to his knees in the soft vetch. "Get me out of this. Make it unhappen. Reverse time. Wipe me out before I did it." The spasmed crouch, was it pain or prayer?

Watching the figure of misery, Ahmed made urgent calculations. The shame-driven need to escape memory was all there was to work with. Use it.

"Carl, you are in a green field in a small park on East E Avenue and Fifth Street. This is a future scene. Two hours from now, you will be rescued and free, without guilt, relaxed and enjoying being outdoors. We are the police, we are getting into a skytaxi to come and get you. What directions are we giving the driver?"

"Amsterdam Avenue and Fifty-third Street to Columbus Avenue, the wrecked blocks, one of the good cellars near the center of the flattened part of the ruins. Buzz it twice. Thanks. I think I can knock down a kid when I hear you and come out and wave. Land and pick me up fast."

"O.K.," said Ahmed straightening and stepping back from the crouched praying figure.

George took his hands from his face. "O.K. what?" His voice was George's usual voice. He got up and brushed small green fronds from his knees.

"O.K., let's make a raid into another kid gang's territory." Ahmed said.

"Where's Biggy?" George looked around as if expecting to see their own gang of kids around them. "Oh, he went to the Canary Islands. And the others they went to the Sahara, they all went . . ." He shook his head as if waking up. "Ahmed, what do you mean raid a kid gang territory? That's all over. We're grown up now."

"We're going to rescue that kidnapped computerman. A mixed gang of teener kids are holding him



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in the ruins near West Fifty-third Street. We know how to handle a kid gang fight."

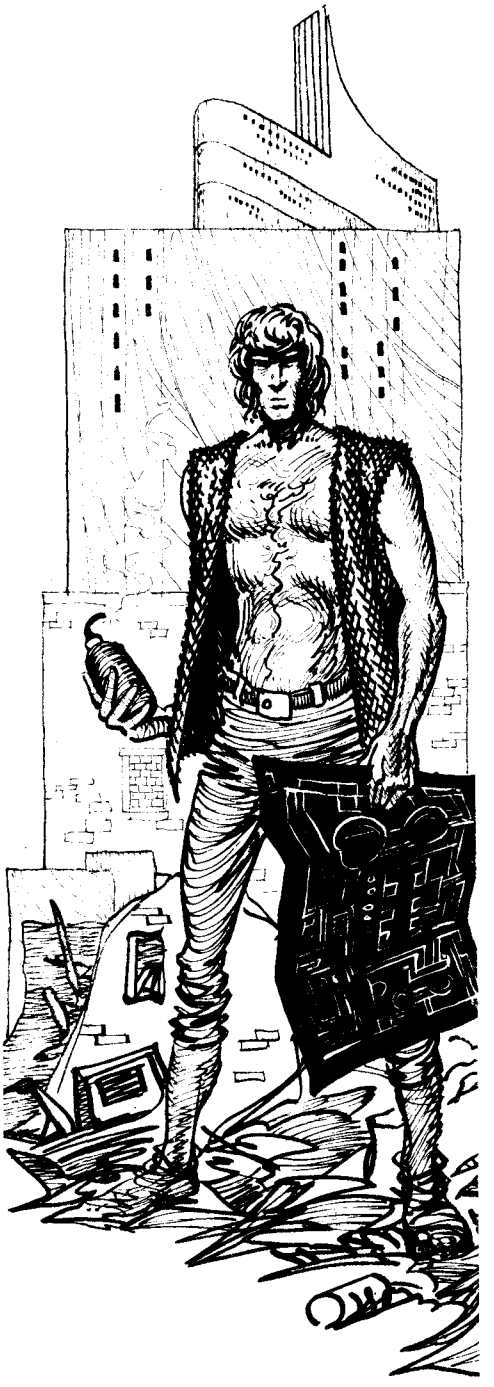
George was not going to let go of common sense. He settled back on the bench and looked around at the green warm comfort of the park, and rubbed one of the bruises on his arm. "Let's call the police, let them do it."

"We are the police, lunk." Ahmed still stood, smiling, depending on the force of his personality, the habit of command to get George to obey. George looked up at him, squinting into the light of the sky, one eye half closed. A half of a bruise showed at the side of his face, most of it hidden by the hairline.

"Ahmed, don't be a nut. Logical thinking doesn't fight chains and clubs for you. I mean your brains are great, but we need muscle against a juv army, because they don't know about thinking, and they don't listen."

"What if they are all in their cellars, lunk, and we want to drop them before they get in deeper and carry Carl Hodges away? What kind of thing could get them all out into the open where a helicopter could drop them with gas?"

George absently rubbed the dark mark on the side of his face. "They come out when somebody gets onto their territory, Ahmed. Not an army of cops or a helicopter, I don't mean that. I mean some poor goof is crossing, looking for a





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shortcut to somewhere else, and they all come out and beat him up."

"That's for you."

"How did you figure . . . Oh, yeah, you don't mean yesterday. You mean strategy, like. They come out to beat me up again and the copter drops them with a gas spray, and maybe there's no one left underground to kill Carl Hodges, or take him away." George got up. "O.K., let's do it."

They came up out of the subway at Fifty-third Street and walked together on the sidewalk opposite the bombed-out shells of old buildings. A distant helicopter sound buzzed in the air.

"Separate, but we keep in touch. Leave your radio open to send, but shut it for receive so there won't be any sound coming out of it. The copter pilot will be listening. I'll circle the block and look in doorways and hallways for trouble. You cut across. We both act like we have some reason to be here, like I'm looking for an address. We're strangers."

"O.K.," George said. "I've got a story for them for cutting across. Don't worry about me." He turned and walked nonchalantly around the corner, across the street, past some standing ruins and into the flattened spaces, and the area that had once been paved back yard, with steps down to doors that had once opened into the cellars of gone buildings. Flattened rubble and standing walls showed where the buildings had been.

He stood in the middle of a back yard, near two flights of cement stairs that led down into the ground to old doors, and he walked onward slowly, going in an irregular wandering course, studying the ground, acting a little confused and clumsy, just the way he had acted the last time he had been there.

The setting sun struck long shadows across the white broken pavement. He turned and looked back at his own long shadow, and started when another person's shadow appeared silently on the pavement alongside of his. He glanced sideways and saw a tall husky teener in a strange costume standing beside him holding a heavy bat. The teener did not look back at him, he looked off into space, lips pursed as though whistling silently.

George winced again when a short teener with straight blond hair stepped out from behind a fragment of standing wall.

"Back, huh?" asked the blond kid.

George felt the shadows of others gathering behind him.

George said, "I'm looking for a pocket watch I lost the night you guys beat me up. I mean it's really an antique, and it reminds me of someone, I've got to find it."

He looked at the ground, turning around in a circle. There was a



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circle of feet all around him, feet standing in ruined doorways, feet on top of mounds of rubble, the clubs resting on the ground as the owners leaned on them, the chains swinging slightly.

"You must be really stupid," said the leader, his teeth showing in a small smile that had no friendship.

Where was Carl Hodges? The area George stood in was clean, probably well used by feet. The stairs leading down to a cellar door were clean, the door handle had the shine of use. The leader had appeared late, from an unlikely direction. He was standing on dusty rubble-piled ground which feet had not rubbed and cleared. The leader then had not wanted to come out the usual way and path to confront George. Probably the usual way would have been the door George was facing, the one that looked used.

It was like playing hot and cold for a hidden object. If Carl Hodges was behind that door, the teeners would not let George approach it. George, looking slow and confused, shuffled his feet two steps in that direction. There was a simultaneous shuffle and hiss of clothing as the circle behind him and all around him closed in closer. George stopped and they stopped.

Now there was a circle of armed teeners close around him. Two were standing almost between him and the steps. The helicopter still buzzed in the distance, circling the blocks. George knew if he shouted, or even spoke clearly, and asked for help the copter pilot would bring the plane over in a count of seconds.

The blond kid did not move, still lounging, flashing his teeth in a small smile as he studied George up and down with the expression of a scientist at a zoo studying an odd specimen of gorilla.

"I got something important to tell you," George said to him. But they didn't listen.

"It's a kind of a shame," the blond kid said to the others. "He's so stupid already. I mean if we just bashed out his brains he wouldn't even notice they were gone."

George faced the leader and sidled another small step in the direction of the steps and the door, and heard the shuffle of feet closing in behind him. He stopped moving and they stopped moving. For sure that door was hiding something. They wanted to keep strangers away from it! "Look, if you found my watch I lost, and if you give it to me, I'll tell you about a thing you ought to know."

If he talked long and confusingly enough, every member of the gang would come out on the surface to hear what he was trying to say. They would all be out in the open. The helicopter was armed for riots, it could spray sleep gas and get every one of them.



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He didn't even feel the blow. Suddenly he was on his knees, a purple haze before his eyes. He tried to get up and fell over sideways still in the curled-up position. He realized he wasn't breathing.

Could a back of the neck karate chop knock out your breathing centers? What had the teacher said? His lungs contracted, wheezing out more air, unable to let air in. It must have been a solar plexus jab with a stick. But then how come he hadn't seen the stick? The purple haze was turning into spinning black spots. He couldn't see.

"What was it he wanted to tell us?"

"Ask him."

"He can't answer, dummy. He can't even grunt. You'll have to wait."

"I don't mind waiting," said the voice of the one carrying a chain. George heard the chain whistle and slap into something, and wondered if it had hit him. Nothing in his body registered anything but a red burning need for air.

"You don't want to trespass on our territory," said a voice. "We're just trying to teach you respect. You stay on the free public sidewalks and don't go inside other people's Kingdoms. Not unless they ask you." The chain whistled and slapped again.

George tried to breathe, but the effort to inhale knotted his chest tighter, forcing breath out instead of in.

It is a desperate thing having your lungs working against you. The knot tightening the lungs held for another second and then loosened. He drew in a rasping breath of cool air, and another. Air came in like waves of light, dispelling the blindness and bringing back awareness of arms and legs. He straightened out from the curled up knot and lay on his back breathing deeply and listening to the sounds around him.

The helicopter motor hummed in the distance. *The copter pilot is listening,* he thought; *but he doesn't know I'm in trouble.*

He heard a clink and a hiss of breath like someone making an effort. He rolled suddenly over to one side and covered his face. The chain hit where he had been. He rolled to a crouch with both feet under him, and for the first time looked at the circle of faces of the teeners who had beaten and made fun of him when he was pretending to be drunk and making believe to be Carl Hodges, and had stumbled into this forbidden territory. He had been retracing Carl Hodges's actions, but he had not been sure it was working. He had been near Carl Hodges here, but he had no proof, no reason to protest when they punished him for violating their boundaries. The faces were the same. Young but cold, some faces were uncertain about punishing an adult, but gaining courage



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from the others. All sizes of teeners in costumes from many communes, but the fellowship and good nature he was used to seeing in groups was missing.

"I used to be in a gang like yours once" he said rapidly to inform the radio listener. "I thought you wouldn't jump me. I didn't come here to get stomped. I just want my antique watch and to tell you something."

He finished the sentence with a quick leap to one side, but the swinging chain swung up and followed, slapped into his skin and curled a line of dents around ribs, chest, and arms. The magnet on the end clanked and clung against a loop of chain. The owner of the chain yanked hard on his handle and the metal lumps turned to teeth and bit in and the chain tightened like rope. George staggered and straightened and stood wrapped up in biting steel chain.

He stood very still. "Hey," he said softly. "That ain't nice."

"Tell us about your news." The circle of teeners and juvs around him were curious about the message he wanted to deliver to them.

George said, "A friend of mine was figuring from my lumps that I got here last time that you've got something important you want me to keep away from. He figures you got the missing computerman. The one who blew up Brooklyn Dome. There's a reward out for him."

A ripple of shock ran through the group surrounding him but the blond kid did not need time to assimilate the threat. Without change of expression he made a gesture of command. "Three of you check the streets. Maybe he brought somebody with him." Three ran silently in different directions.

"I'm just doing you a favor telling you what people say," George said in stupid tones. "Now you gotta do me a favor and help me get my watch back."

"Favor?" screamed the tall, misproportioned one with the chain. "Favor? You stupid fink, you should have kept your stupid mouth shut." He yanked hard on the chain to make its teeth extend more sharply.

An outraged force had been expanding in George's chest. He stood still looking meek and confused one more second, watching his captors snarl and hate him for having "told his friend." Then he bent forward and butted the chain holder down, rolled over his form to the cement and rolled rapidly down three small cement steps, unrolling the chain behind him. He came up on one knee reaching for the chain as a weapon. It was a seven-foot chain with a handle at each end. A heavy chain is a terrible weapon in the hands of a strong man. If it had been behind him at the moment of impulse, he would have swept it around and forward and cut them down like grass. He gathered it looped into



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his hands, eyeing the crowd of oddly dressed teeners that was his target. His speed was too fast to intercept, his motions too smooth to look fast. He threw the chain up into the air behind him then arched back with every muscle tight and bent forward with a grunt of effort, ignoring two clubs that bounced off his shoulders, bringing the chain forward with a tremendous released surge of force that was rage. The teen gang scattered and fled and the chain swung its cutting deadly circle through the air where they had been.

"Dumb punks." George breathed noisily with the effort. "Whyncha act like brothers? Can't let anybody be your friend. Trying to be smart not knowing . . ."

He stopped and let the swinging chain drag along the ground, slowing. He rippled it in and let it wrap around his arm, with a short murderous loop of it in his hand. The sun had set and it was growing darker in the corners and harder to see. George fended off a flung stick by deflecting it with the chain, then grabbed a club for his other hand. Something whistled by and clanged against a wall. Probably a knife. The teener leader would see that George knew too much, and instruct the gang to kill him. The boy was logical and ruthless and would decide a stranger's life was less important to him than the million he hoped to gain from selling the computerman's answers.

"Carl Hodges," George bellowed. "Ally ally infree. I need help. Computerman Carl Hodges, come out." The police riot control man in the circling copter would at last hear a request for help, and bring his plane in fast. The teeners would only hear him yelling Carl Hodges's name and still not be sure the police were near.

The cellar door gave two thumps and a crash and fell forward off its rusty hinges across the steps. A man fell out on top of it and scrambled across the door and up the steps without bothering to straighten from all fours.

At the top he straightened and looked at George. The other man was thin and balding, wiry and a little under average in size totally unlike George in either shape or face, but the impression of lifetime familiarity was overwhelming. His own eyes looked out of the strange face.

George handed him a club from the ground. "Guard my back. They are going to try to take you alive, I think, but not me." He spun slowly looking and listening, but all was quiet. Teeners lurked in a distance along the routes George would use if he tried to escape.

George looked back at Carl Hodges and saw the thin computerman inspecting George's appearance with a knot of puzzlement between his brows. Looking at him was like looking into a mirror.



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"Hello, me over there," George said.

"Hello, me over there," the man said. "Are you a computerman? When I get back on the job do you want to come play City Chess with me? Maybe you could get a job in my department."

"No, buddy, we are us, but I don't play City Chess. I'm not like you."

"Then why . . ." Carl Hodges ducked a flung club and it clattered against the cement. *Then why do I have this impression of two people being the same person?* he meant.

"We have an empathy link in our guts," George said. "I don't think like you. I just feel what you feel."

"God help anyone who feels the way I feel," Hodges said. "I see some kids advancing on my side."

"Hold them off. Back to back. All we need is a little time." George turned away from him again, and searched the corners with his eyes, ready for a rush. "About the way you feel. It's not all that bad. I'll get over it."

"I did it," Carl Hodges said. "How do I get over it. I feel . . . I mean, I have a reason, for feeling . . . I got drunk and the egg hit the fan. How do I get over *that*?" His voice was broken by grunts of effort and things clattered by, deflected, missing them and hitting walls and cement flooring.

They stood back to back and fended off bricks, sticks, and glittering objects that he hoped were not knives. "We can get killed if we don't watch it. That's one way," George said. A stick came through the air and rapped George's ear as he fended it off with his stick. The attackers advanced, silhouettes against the dimming view of stone walls. Another attacker shadow picked up the clattering stick from the ground and threw it back as he advanced.

"Ouch," said Carl Hodges. "Duck." They both ducked and a flung net went by. "We fight well together, we must get together and fight another teen gang sometime. Right?" said his brisk voice. "Ouch, damn."

George received a rush by the tallest of the gang, caught at the outstretched staff and yanked the enemy past. He tried to trip the teener as he hurtled by, but missed and turned to see him neatly tripped by a stick between the ankles by Carl. The teener went face forward to the ground, and rolled, getting out of range.

"Good pass!" Several new and heavy blows on head and shoulders reminded George to watch his own side. Dizzied, he spun, bracing the staff for a pushing blow with both hands, and felt it strike twice against blurred forms. He reversed it and struck down at an attacker with a contented growl.

With a heavy thrumming and a push of air the police helicopter came over a wall swooping low,



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like an owl settling over a nest of mice, and released a white cloud of gas over them all.

George took a deep breath of the clear air before the cloud reached him. Beside him Carl Hodges took a deep startled breath of the white cloud and went down as suddenly as if a club blow had hit.

Still holding his breath George straddled him, and stood alert peering through the fog at shapes that seemed to be upright and moving. Most of the teeners had run away, or gone down flat on the ground. What were these shapes? Eighteen seconds of holding his breath. Not hard. He could make two minutes usually. He held his breath and tried to see through the white clouds around him. The sound of the helicopter circled, in a wider and wider spiral, laying a cloud of gas to catch all the running mice from the center of the area to its edges.

The shapes suddenly appeared beside him, running, and struck with a double push, flinging him back ten feet and skidding on his back on the sandy concrete. He remembered to hold his breath after one snort of surprise and silently rolled to his feet and charged back.

Carl Hodges's unconscious form was missing. George saw movement through the white fog ahead, heard feet scuffing cement and across hollow wood, and he charged in pursuit of the sounds. He half fell, half slid down the cement steps, across the wooden door on the ground and into a corridor, and glimpsed motion ahead, and heard a closet door shutting. Holding his breath, groping, he opened the door, saw broken wall with an opening, smelled the wet smell of cement and underground drafts, and leaped over a pile of ancient trash brooms into the opening.

Safe to breathe here. As he took a deep breath a brilliant flashlight suddenly came on, shining blindingly in his face from only two feet away. "I have a gun pointed at you," said the precise voice of the blond short teener. "Turn left and walk ahead in the directions I tell you. I could kill you here, and no one would find your body, so try to keep my good will."

"Where is Carl Hodges?" George asked, walking with his hands up. The flashlight threw his shadow ahead of him big and wavering across the narrow walls.

"We're all going to be holing down together. Turn left here." The voice was odd.

As he turned George looked back and saw that the short teener was wearing a gas mask. As he took a breath to ask why, the white fog rolled down from a night-sky crevice above them. It smelled damp and slightly alcoholic.

"Keep moving," said the teener, gesturing with his gun. George turned left, wondering what hap-



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pened next when you breathed that fog. A busy day, a busy night. An experience of symbolic insight was often reported by people who had been flattened by police anti-riot gas. What had the day meant? Why were such things happening?

Floating in white mist, George floated free of his body over the city and saw a vast spirit being of complex and bitter logic who brooded over the city and lived also in its future. George spoke to it, in thoughts that were not words. "Ahmed uses the world view of his grandmother, the gypsy. He believes that you are Fate. He believes you have intentions and plans."

It laughed and thought. *The wheels of time grind tight. No room between gear and gear for change. Future exists, logical and unchangeable. No room for change in logic. When it adds up, it must arrive at the same concluding scene. The city is necessity. The future is built. The gears move us toward it. I am Fate.*

George made a strange objecting thought. "The past can change. So everything that adds up from the past can change."

There was a wail from the atmosphere. The vast spirit that brooded over the city vanished, destroyed, dwindling to nowhere, uncreated, never true, like the Wicked Witch of the West when Dorothy poured a bucket of water over her, leaving behind the same dwindling wail, "But all my beautiful disasters, the logic, the logic . . ."

"No arithmetic," George said firmly. "If you can see the future, you can change it. If you can't see the past, it can change by itself and be anything. It won't add up the same twice."

All the crystallized visions of the city of the future shattered and dissolved into white fog, a creative fog that could be shaped to anything by thought. George stood at the center of creation and felt stubborn. They were tempting him again, trying to get him into the bureaucratic game of rules and unfreedom. "No," he said. "I won't fence anyone in with my idea. Let them choose their own past."

He came to consciousness lying on the floor in a small tight room with the blond kid sitting on a bed pointing a gun at him.

"They got Carl Hodges back," the kid said. "You ruined everything. Maybe you are a cop. I don't know. Maybe I should kill you."

"I just had a wild dream," George said, lifting his head, but not moving because he did not want to be shot. "I dreamed I talked to the Fate of New York City. And I told Fate that the future can change anytime, and the past can change anytime. In the beginning was the middle, I said. And Fate started crying and boo-hooing and vanished. I mean no more Fate. Vanished."



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There was a long pause while the short blond kid held the pistol pointed at George's face and stared at him over the top of it. The kid tried several tough faces, and then curiosity got the better of him. He was basically an intellectual, even though a young one, and curiosity meant more to him than love or hate. "What do you mean? The past is variable? You can change it?"

"I mean, we don't know what happened in the past exactly. It's gone anyhow. It's not real anymore. So we can say anything happened we want to have happened. If one past is going to make trouble, we can change it just by being dumb, and everything will straighten out. Like, for example, we just met, right now, right here, we just met. Nothing else happened."

"Oh," the kid put away his gun, thinking about that. "Glad to meet you. My name's Larry."

"My name's George," he arranged himself more comfortably on the floor, not making any sudden moves.

They had a long philosophical discussion, while Larry waited for the police outside to finish searching and go away. Sometimes Larry took the gun out and pointed it again, but usually they discussed things and exchanged stories without accepting any past.

Larry was serious and persuasive in trying to convince George that the world had too many technicians. "They don't know how to be human beings. They like to read about being Tarzan, or see old movies and imagine they are Humphrey Bogart and James Bond, but actually all they have the guts to do is read and study. They make money that way, and they make more gadgets and they run computers that do all the thinking and take all the challenge and conquest out of life. And they give a pension to all the people who want to go out into the woods, or surf, instead of staying indoors pushing buttons, and they call the surfers and islanders and forest-farmers Free Loaders, and make sure they are sterilized and don't have children. That's genocide. They are killing off the real people. The race will be descended from those compulsive button pushers, and forget how to live."

It was a good speech. George was uneasy, because it sounded right, and he was sure no man was smart enough to refute the killer, but he tried.

"Couldn't a guy who really wanted children earn enough money to get a breeding permit for himself and an operation for his wife?"

"There aren't that many jobs anymore. The jobs that are left are button-pusher jobs, and you have to study for twenty years to learn to push the right button. They're



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planning to sterilize everyone but button-pushers."

George had nothing to say. It made sense, but his own experience did not fit. "I'm not sterilized, Larry, and I'm a real dope. I didn't get past the sixth grade."

"When did your childhood support run out?"

"Last year."

"No more free food and housing. How about your family, they support you?"

"No family. Orphan. I got lots of good friends, but they all took their pensions and shipped out. Except one. He got a job."

"You didn't apply for the unemployable youth pension yet?"

"No. I wanted to stay around the city. I didn't want to be shipped out. I figured I could get a job."

"That's a laugh. Lots of luck in getting a job, George. How are you planning to eat?"

"Sometimes I help out around communes and share meals. Everyone usually likes me in the Brotherhood communes." George shifted positions uneasily on the floor and sat up. This was almost lying. He had a job now, but he wasn't going to talk about Rescue Squad, because Larry might call him a cop and try to shoot him. "But I don't bum meals."

"When's the longest you've gone without meals?"

"I don't feel hungry much. I went two days without food once. I'm healthy."

The kid sat crosslegged on the bed and laughed. "Really healthy! You got muscles all over. You've got muscles from ear to ear. So you're trying to beat the system! It was built just to wipe out muscleheads like you. If you apply for welfare, they sterilize you. If you take your unemployable support pension, they sterilize you. If you are caught begging, they sterilize you. Money gets all you muscleheads sooner or later. It's going to get you, too. I'll bet when you are hungry you think of the bottle of wine and the big free meal at the sterility clinic. You think of the chance of winning the million sweepstakes if the operation gives you the right tattoo number, don't you?"

George didn't answer.

"Maybe you don't know it, but your unemployable pension is piling up, half saved for every week you don't claim it. You've been avoiding it a year almost? When it piles high enough, you'll go in and claim your money and let them sterilize you and ship you out to the boondocks, like everyone else."

"Not me."

"Why not?"

George didn't answer. After a while he said, "Are you going to let them sterilize you?"

Larry laughed again. He had a fox face and big ears. "Not likely. There are lots of ways for a smart guy to beat the system. My descendants are going to be there the year



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the sun runs down and we hook drives to Earth and cruise away looking for a new sun. My descendants are going to surf light-waves in space. Nobody's going to wipe me out, and nobody's going to make them into button-pushers."

"O.K., I see it." George got up and paced, two steps one way, two steps the other way in the narrow room. "Who are you working for, Larry? Who are you crying over? People who let themselves be bribed into cutting off their descendants? They're different from you. Do they have guts enough to bother with? Are they worth getting your brain wiped in a court of law? You're right about history I guess. I'm the kind of guy the techs are trying to get rid of. You're a tech type of guy yourself. Why don't you be a tech and forget about making trouble?"

At the end of the room, faced away from Larry, George stopped and stared at the wall. His fists clenched. "Kid, do you know what kind of trouble you make?'

"I see it on television," Larry said.

"Those are real people you killed," George still stared at the wall. "This afternoon I was giving artificial respiration to a girl. She was bleeding from the eyes." His voice knotted up. Big muscles bulged on his arms and his fists whitened as he tried to talk. "She was dead, they told me. She looked all right, except for her eyes. I guess because I'm stupid." He turned and his eyes glittered with tears and with a kind of madness. He glanced around the small room looking for a thing to use for a weapon.

Larry took out his gun and pointed it at George hastily getting off the bed. "Oh oh, the past is real again. Time for me to leave!" Holding the gun pointed steadily and carefully at George's face he used his other hand to put on black goggles and slung the gas mask around his neck. "Hold still, George, you don't want a hole through your face. If you fight me, who are you working for? Not your kind of people. Think, man." He backed to the door. George turned, still facing him, his big hands away from his sides and ready, his eyes glittering with a mindless alertness.

Larry backed into the dark hall. "Don't follow. You don't want to follow me. This gun has infrasights, shoots in the dark. If you stick your head out the door, I might shoot it off. Just stand there for ten minutes and don't make any trouble. The gun is silenced. If I have to shoot you, you don't get any medal for being a dead hero. No one would know."

The short teener backed down the dark corridor and was gone.

George still stood crouched, but he shook his head, like a man trying to shake off something that had fallen over his eyes.



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He heard Larry bump into something a long way down the corridor.

"I would know," a voice said from the ceiling. Ahmed let himself down from a hole in the ceiling, hung by both long arms and then dropped, landing catlike and silent. He was tall and sooty and filthy and covered with cobwebs. He grinned and his teeth were white in a very dark face. "You just missed a medal for being a dead hero. I thought you were going to try to kill him."

He twiddled the dial of his wrist radio, plugged an earphone into one ear and spoke into the wrist radio. "Flushed one. He's heading west on a cellar corridor from the center, wearing a gas mask and infragoggles, armed and dangerous. He's the kingpin, so try hard, buddies."

George sat down on the edge of the bunk, sweating. "I get too mad sometimes. I almost did try to kill him. What he said was probably right. What he said."

Ahmed unplugged the speaker from his ear. "I was mostly listening to you, good buddy. Very interesting philosophical discussion you were putting out. I kept wanting to sneeze. How come you get into philosophical arguments today and I just get beat up? Everything is backward."

"You're the smart one, Ahmed," said George slowly, accepting the fact that he had been protected. "Thanks for watching." He looked at his own hands, still worrying slowly on an idea. "How come everything the kid said made sense?"

"It didn't," Ahmed said impatiently. "*You* made sense."

"But Larry said that techs are wiping out non-techs."

"Maybe they are, but they aren't killing anybody. The kid kills."

George pushed his hands together, felt them wet with sweat and wiped them on his shirt. "I almost killed the kid. But it felt right, what he was saying. He was talking for the way things are and for the way they're going to be, like Fate."

"Killing is unphilosophical," Ahmed said. "You're tired, George, take it easy, we've had a long day."

They heard a police siren wail and then distant shots. Ahmed plugged the earphone into his ear. "They just dropped somebody in goggles, gas didn't work on him. They had to drop him with hypo bullets. Probably Larry. Let's try to get out of here."

They put a wad of blankets out into the corridor, head high. No shots, so they went out cautiously and started groping down the long black hall, looking for an exit.

Ahmed said, "So you think Larry was the fickle finger of Fate on the groping hand of the future. No power on Earth can resist the force of an idea whose time has come, said somebody once. But Good-buddy, when I was listening to you whilst lying in the ceiling



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with the spiders crawling on me, I thought I heard you invent a new metaphysics. Didn't you just abolish Fate?"

The corridor widened, and George felt a draft of fresh air without dust, and saw a glimmer of light through a hole. They climbed through and saw a doorway, and a broken door. "I don't know, Ahmed," he said vaguely. "Did I?"

They climbed up the broken door and a flight of stone steps and found themselves in a deserted yard at the center of the ruin. It was quiet there. In the distance around the edges of the block police copters buzzed, landed in the streets.

"Sure you did," Ahmed said. "You abolished Fate. I heard you."

George looked up at the moon. It was bright and it shone across the entire city, like the evil Fate in his dream, but it was only the moon, and the city was quiet. Suddenly George leaped into the air and clicked his heels. "I did. I did." He bellowed. "Hey everybody! Hey, I did it! I abolished Fate!"

He landed and stopped leaping, and stood panting. The red glow in the sky over New York blinked on and off, on and off from the giant sign they could not see.

"Congratulations," said Ahmed and rested an arm briefly across his shoulders. "May I offer you a tranquilizer?"

"No, you may offer me a meal," George said. "No, cancel that, too. Judd gave me money yesterday. Steaks, hot showers, hotel room. *Wow*. I've got a job." He turned abruptly and walked away. "See you tomorrow. *Wow*."

Left alone, tall and tired, smeared with dirt and itchy with cobwebs, Ahmed stared after him, feeling betrayed. Where was all the respect George used to give him? George was a short fat kid, once, and treated Ahmed like a boss. Now he was beginning to loom like a Kodiak bear, and he walked away without permission.

Ahmed looked up at the lopsided moon. "Mirror, Mirror on the wall, who's the smartest guy of all? Don't answer that, lady. It's been a long day. I'm tired." ■

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## Willy Ley on the Moon

*On the far side of the Moon, at 43N., 154E. there is a crater named Ley. Willy Ley is, officially by decision of the international naming commission, permanently on the Moon, as he deserved to be.*

*By coincidence, a short distance northeast of Ley, there is a crater named Campbell. For W. W. Campbell, an astronomer who specialized in the study of radial velocities of stars, however.*

*Science fiction is really well represented; H. G. Wells is at 41N., 122E. Dean McLaughlin is at 47N., 93W.—though that's actually our author's father, who studied the spectra of novae. And H. Gernsback is at 36S., 99E.*



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# CELESTIAL X RAYS

by Margaret L. Silbar

*It's long been obvious that those immense fusion generators, the stars, were bound to radiate X rays, and that no Earth-bound observer would ever "see" them through the shielding atmosphere. But the things that have been found by X-ray astronomy weren't expected!*

For three thousand years, an Earth-bound astronomer could only study the stars with his eyes. With Galileo's invention of the telescope, eyes were helped by bigger and better light collectors. But astronomy remained an optical science, dependent on the human eye—and photographic plate—which had evolved to see the available electromagnetic radiation—light—coming through our atmosphere. Then, in the 1930s, Karl G. Jansky detected radio waves—the other electromagnetic radiation which penetrates the atmosphere—*coming from the direction of the Milky Way. A New Astronomy was born, but even with its new tools, giant radio telescopes, astronomers still could not study many of the energetic processes taking place in the stars. For they were unable to look through the protective blanket

*One wonders if there are organisms on Earth which have evolved to "see" radio waves.



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which is our atmosphere at the other kinds of electromagnetic radiation present in outer space.

Only recently, with rocket-borne instruments carried above this blanket, astronomers have found they have an undimmed view of the electromagnetic spectrum and of the heavens. Among the New Astronomies now possible is that science which detects and studies the heavenly X rays and gamma rays.

Astrophysicists had long suspected, and verified two decades ago, that the sun emits X rays, albeit only a few. This in no way prepared them for the discovery, in 1962, of an X-ray source in the heavens emitting X rays a trillion times more intensely than the sun! Since then, more than 40 discrete and intense X-ray sources, all thought to be stars or supernova remnants, have been uncovered. Two of these sources have been identified with optical objects. In addition to the "bright" discrete X-ray sources, a diffuse X-ray background has also been discovered.

These astronomical X-ray sources are quite varied and peculiar. For example, last year, the Vela Satellites—vela is Spanish for "vigil"—watched an X-ray star in the southern sky "turn on." This new source emitted *twice* the X-radiation of the first source seen in 1962, according to a group at Los Alamos Scientific Laboratory, and it has now "switched off." Other sources have also shown their variability—though not in such an extreme fashion. This variability only compounds the puzzle.

At this point, no one can say with any certainty what is causing this X-radiation. As we learn more



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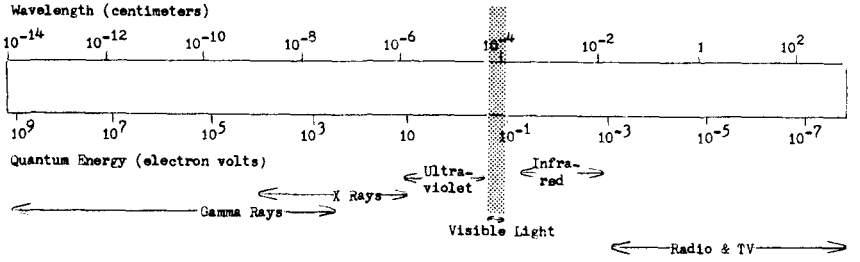


*Fig. 1. The electromagnetic spectrum from short-wavelength, high-frequency gamma rays to long-wavelength, low-frequency radio and TV waves is shown here. The X ray region of the spectrum is from .1 to 100 angstroms (1 A = $10^{-8}$ cm).*

about how X rays are generated in cosmic space, we may also learn more about the evolution of stars, galaxies, and our universe. For it has long been recognized in science that it is the puzzles which lead to new discoveries. One discovery that some astrophysicists are predicting is that, one day, X-ray galaxies will be known to be as common in the universe as radio galaxies, and these as-yet-undiscovered galaxies may have a comparable range of luminosities.

Another possibility is that X-ray astronomy may help us choose between the big-bang and steady-state cosmological models of the origin of the universe. If the isotropic background X-radiation is radiation from the edge of our universe, it might come from X rays created in an initial primordial explosion, that is, a big bang.

Before proceeding to talk about the various theories proposed to explain this strange and unexpected astronomical X-radiation, a definition of the X-ray region of the electromagnetic spectrum is in order. (See Fig. 1). Electromagnetic radiation is "quantized," i.e., comes in indivisible packets of energy, called photons. In the kinds of phenomena discussed here, the radiation has more of a particle nature than a wave nature. The photon energies range from above the ionization energy of hydrogen —20 to 30 eV/photon—up to a region of nuclear gamma ($\gamma$) rays —about or more than 100 keV/photon.*

*An electron volt abbreviated eV, is a convenient unit of energy; 1 eV is the amount of energy an electron gains when it falls through a potential of 1 volt. 1 keV, a kilo-electron-volt, is 1,000 eV.



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The more energetic the photon, the "harder" it is and the shorter its wavelength—measured in angstroms, 1 A = $10^{-8}$ cm.

Since Roentgen's discovery that photographic plates wrapped in black paper were fogged by something unknown—hence called "X rays"—we have come to think of X rays as penetrating. But we live and work under the equivalent of a meter of lead. Essentially, none of the celestial X rays get through the atmosphere, and to see them astronomers must get up there where the air is *really* thin. Hence, the need for rockets and satellites as astronomical tools.

X-ray astronomy may be said to have had its beginnings in Bengt Edlen's 1942 model explaining the solar corona. Edlen's purpose was not to explain solar X-ray emission, which he had no inkling existed, but, nonetheless, the production of X rays is implicit in this model. What Edlen did do was to identify most of the corona's mysterious spectral lines as emissions from elements such as iron that had been from nine to thirteen times ionized. Such highly ionized iron, he said, could exist only if the sun's outer layer were a gaseous envelope of very low density with a very high temperature of $10^6$ degrees K.—which we now know is indeed that hot. Edlen was essentially saying that the corona is a plasma, an electrically-neutral "gas" teeming with positive and negative ions, free and bound electrons. It turns out that such a plasma must emit X-ray photons.

Even before the end of World War II, German astrophysicists tried to detect the solar X-radiation expected on the basis of this model, but failed. The initiative was thus seized by the United States as soon as confiscated German V-2 rockets were brought to this country. Solar X rays were first seen in 1949 on Schumann plates carried in the nose cone of a V-2 rocket. These were photographic plates wrapped in aluminum and beryllium foil, which—as in Roentgen's discovery—could only have been exposed by penetrating X rays.

The sun's X-ray output is equal to about a millionth of its visible light output. Various kinds of reactions give rise to the X-ray emission from the quiet corona, the sun's outermost layer, and the emission rates for various X-ray wavelengths are shown in Table 1. All of these reactions are mixed up in the coronal plasma in a very complicated steady state being fed by energetic processes in the solar core. Photons (X rays) leak out of the corona, as does the solar wind.

What are these X-ray producing reactions? There are elastic scattering processes taking place in the plasma where, in the simplest case, an electron scatters off a positive iron ion,

$$e^- + Fe^+ \longrightarrow e^- + Fe^+.$$



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**TABLE 1. X RAY EMISSION FROM THE QUIET SUN**

| RANGE | FLUX (*minimum*) | FLUX (*maximum*) |
|---|---|---|
| 0-10 A. | $10^{-5}$ | $2\text{-}3 \times 10^{-3}$ |
| 10-20 A. | $10^{-4}$ | $1\text{-}2 \times 10^{-2}$ |
| 20-44 A. | —— | —— |
| 44-60 A. | $10^{-2}$ | $5 \times 10^{-2}$ |

From 1960 to 1964, when solar activity ranged from near maximum to near minimum, the X-ray emission—in the absence of flares—in ergs/cm$^2$ sec. was as above.

No X rays are created in this reaction; it serves to keep the temperature of the plasma locally uniform. There are also inelastic processes such as collisional excitation. Here, an electron bumps into an iron ion,

$$e^- + Fe^+ \longrightarrow Fe^{+*} + e^-.$$

The iron ion is excited—$Fe^{+*}$—when one of its outer bound electrons is kicked to a higher Bohr orbit by the collision. The excited ion rapidly decays, giving rise to a photon, or X ray,

$$Fe^{+*} \longrightarrow Fe^+ + \gamma.$$

When the iron ion decays, it can only decay back to its ground state, the state the ion was in before it got excited. The photon carries away the energy used in exciting the ion—or the energy lost in deexciting it. Since quantum mechanics requires that $Fe^+$ and $Fe^{+*}$ have very definite energies, collisional excitation gives rise to *discrete* spectral lines, some of which appear in the X-ray spectrum.

Another kind of inelastic process occurs when the electron loses energy in bouncing off the ion without exciting it,

$$e^- + Fe^+ \longrightarrow e^- + Fe^+ + \gamma.$$

This is called bremsstrahlung—from the German word for "braking radiation." Here, the electron has a large kinetic energy to start with; as it scatters, it loses some of this energy. As the electron—a charged particle—decelerates, it must radiate a photon by Maxwell's laws of electromagnetism. The photon energy equals the kinetic energy lost by the electron as it bounces from the iron ion. Bremsstrahlung involves free electrons, and such electrons—because they can have *any* kinetic energy—give rise to a *continuous* X-ray spectrum.

A case rather like bremsstrahlung, except that the electron sticks to the ion to form a neutral atom,



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is called recombination,

$$e^- + Fe^+ \longrightarrow Fe^0 + \gamma,$$

and it also gives rise to a continuous spectrum. Here the photon energy is the sum of the kinetic energy of the original electron plus the potential energy gained when the electron was captured and bound by the iron ion. Recombination is probably more dominant as a source of X rays in the quiet solar corona than bremsstrahlung is.

A word of warning is in order at this point. The above explanation for the production of X rays in the solar corona is oversimplified. These kinds of processes do occur, but in an exceedingly complicated fashion, involving not the few reactions we have described, but *many* reactions. All of the processes so far discussed are cases of thermal radiation; that is, they are all dependent on the high coronal temperature. There would not be enough energy available to create free electrons if the coronal temperature were lower. The solar core, meanwhile, in some manner not yet understood, feeds energy into the corona to help it maintain its high temperature.

Just as the corona brightens with sunspot activity, so does the X-ray flux. The sun also emits X rays in bursts from active coronal regions above sunspots often, but not always, occurring simultaneously with solar flares, or storms. Essentially, X-radiation from the active corona is the same as that from the

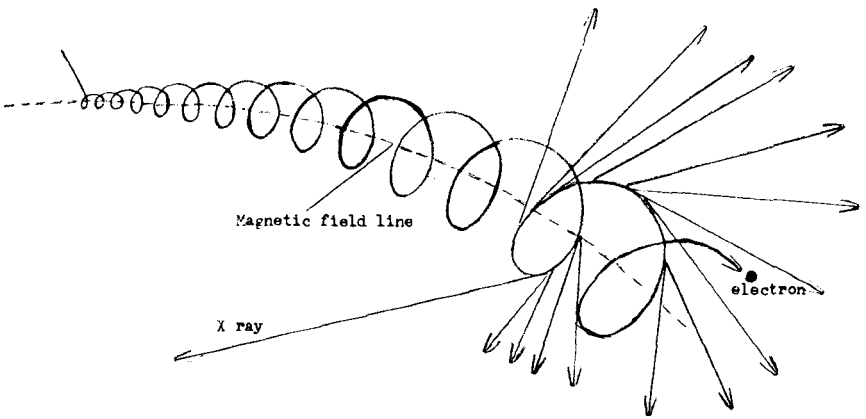


*Fig. 2. In synchrotron radiation, the rapid gyration of high energy electrons in a strong magnetic field throws off X rays (photons) in all directions, more or less perpendicular to the magnetic field line.*



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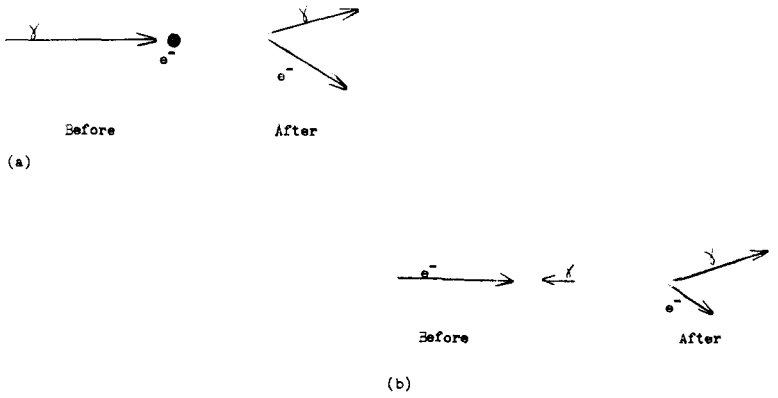
quiet corona, only there is more of it and it is not as well understood. High-energy flare photons with energies up to 100 keV* have been explained by saying they were generated in a plasma with a temporarily high temperature of $10^8$ degrees K.

There might be other ways of generating solar X rays. If there is some nonthermal source producing high-energy electrons, then these electrons could bring about continuous X-radiation via bremsstrahlung, synchrotron radiation, or the inverse Compton effect. Bremsstrahlung we have already talked about. Synchrotron radiation is caused by the rapid gyration of high-energy electrons in a strong magnetic field, as is shown in Fig. 2. To execute these spirals, the electrons must be subjected to a force that turns them away from the straight and narrow. As before, it is a fact of electromagnetic life that this acceleration leads the charged electrons to radiate photons.

The usual Compton effect corresponds to a laboratory situation in which a high-energy photon scatters off an electron at rest, as in Fig. 3a. The photon loses energy, and the electron gains energy. In the inverse Compton effect, shown in Fig. 3b, an energetic electron scatters off a photon and the pho-

*Such high-energy flare photons are a hazard to the space traveler.

*Fig. 3. In (a), Compton scattering takes place when a high-energy photon scatters off an electron at rest with the photon losing energy and the electron picking up energy. In (b), inverse Compton scattering is shown. Here, a high-energy electron meets a low-energy photon: the electron loses energy after the collision, the photon gains energy.*



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ton gains energy. It is not clear at this time that these nonthermal processes actually contribute to the solar X-ray output.

In 1962, a group at American Science and Engineering made the first X-ray survey of the sky, with an instrumented Aerobee rocket flying 140 miles above the Earth's surface. No one in the group expected to see much since the assumption was that other stars would give off no more X-radiation than the sun. The most anyone hoped for was to detect lunar X rays produced by fluorescence from solar X rays impinging on the moon. Then, perhaps later, instruments sensitive enough to search directly for X rays from stars could be designed and flown. The Geiger counters aboard the rocket scanned a 120-degree belt of the sky in the moon's vicinity, finding no evidence whatsoever of X rays coming from the moon. But the rocket did detect an intense source of nonlunar X rays—two to eight angstroms in wavelength—"close to the center of the galaxy, but not quite coincident with it." This source in the constellation Scorpius, now known as SCO XR-1, has a total X-ray emission of $6 \times 10^{36}$ ergs/sec, more than 1,000 times the emission of the sun at all wavelengths. There are some strange things up in the sky. That same pioneering flight also found evidence of a weaker X-ray star in the constellation Cygnus. The following year, the existence of SCO XR-1 and CYG XR-1 were verified, and a source in the Crab Nebula, with an X-ray emission about an eighth that of SCO XR-1, was discovered.

Astrophysicists were understandably puzzled by all this. A first thought was that SCO XR-1's intense radiation was a cumulative effect, resulting from many stars in the galactic center each emitting X rays at a rate comparable to the sun's. An estimate was made, however, and there are nowhere near enough stars to account for the observed radiation. A second thought had to do with the strong radio signals, which no one understands, also emanating from the galactic center. Perhaps the same process responsible for these radio signals might also cause X rays. After further observation, this explanation was also discarded because SCO XR-1 is much more localized than these radio sources.

For example, SCO XR-1 was located within a two-degree arc in the sky. Astrophysicists thus began to suspect it of being a discrete object, a single star. The problem now was to explain why a star emitting such tremendous amounts of energy could neither be seen nor heard. The most popular explanation until recently was that SCO XR-1 and the other X-ray sources were the as-yet-hypothetical neutron stars, perhaps seen as pulsars.



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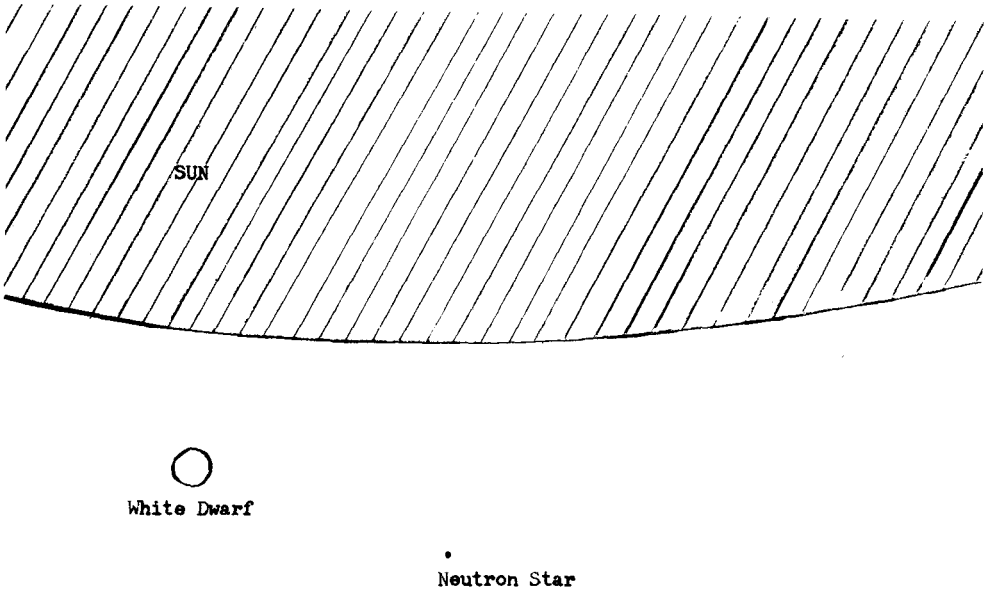


*Fig. 4. The sun's diameter is nearly a million miles (and, if drawn to scale here, would be about 40 inches). A typical white dwarf has a 6,000-mile diameter and a neutron star, a 10-mile diameter. Yet all three of these objects have about the* same *mass, which is an indication of how very dense a neutron star is.*

In the course of stellar evolution, some stars run out of fuel and collapse in a supernova burst, leaving behind a core of neutrons with a density of the order of $10^{15}$ g/cm$^3$. SCO XR-1 was said to be such a star with a radius of 10 kilometers. (The sun, squeezed to such densities, would, as is shown in Fig. 4, have only a 20-kilometer radius.) Presumably, a neutron star could have a core temperature as high as 10 million degrees. This is a sufficiently high temperature to give the observed amount of X-radiation, which would be thermal in the same sense as is the solar radiation. There would just be more of it because of the higher temperature. To explain the diverse X-radiation from SCO XR-1—radiation both below 10 A and from 44 to 50 A—some astrophysicists envisioned a vibrating neutron star with a corona and a stellar wind.

The idea of SCO XR-1, at least, being a neutron star was enhanced by ancient Chinese, Japanese, and Arabic records which list five possible supernova explosions in the neighborhood. One intriguing report comes from 827 A.D. when Haly and Giafar Ben Mohammad Albumazar in Babylon noted a new star in Scorpius which was as bright as the quarter moon and remained visible for four months.



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It was only natural to carry these ideas over to the Crab Nebula, which is known for sure to be the remnant of a violent supernova burst—brighter than Venus—recorded by Chinese and Japanese astronomers in 1054 A.D.* To settle the question of whether or not the X-ray source in the nebula was due to a neutron star, a Naval Research Laboratory group in 1964 measured its angular size, using lunar occultation of the source, in a beautiful experiment. If the X-ray source in the nebula were indeed a superdense star with a radius of only a few kilometers, then the X-radiation would be abruptly shut off as the moon eclipsed the source. The experiment involved some tricky timing, for, if it failed, it could not be repeated for nine years until the moon again eclipsed the nebula in 1973. (Luckily, a half-completed rocket was already available at the time the experiment was proposed.) It would, moreover, take the moon about twelve minutes to block out the entire nebula, and the astrophysicists had only five minutes of rocket observation time. They chose to use this time to study the central portion of the nebula. The X-radiation did not turn off quickly. The source was definitely not a neutron star! With an angular size of about one minute of arc, the X-ray source extended over the entire central region, but it was not as large as the visible Crab Nebula.

The neutron star theory of X-ray sources thus received a rather strong blow in this experiment. But no one was quite yet ready to throw it out. Nor could any one settle the question once and for all by a lunar occultation experiment on SCO XR-1, for this source is in a part of the sky which is never eclipsed by the moon.

The theory was rejuvenated after astrophysicists looked more closely at two X-ray stars in the constellation Cygnus. These sources are highly variable on time scales as short as a month, and had they not been found, X-ray astronomy might have seemed to be the study of relatively stable objects. It was CYG XR-1 which specifically boosted the neutron star theory of X-ray sources back into a favored position. In 1964, CYG XR-1 was the second strongest X-ray star in the sky. A year later, its X-ray flux —1-10 A—had decreased by a factor of four—while CYG XR-2's X-ray emission remained unchanged. This rapid fall off in intensity led some astrophysicists to conclude that CYG XR-1 once may have been much brighter. (Or, perhaps it was "flaring" when mapped in 1964?) The point of all this is that the rapid variation measured in CYG XR-1 seemed to fit the time constants predicted by the neutron star theory.

*The Crab Nebula, incidentally, has taught us almost all we know about supernova explosions.



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The fact that SCO XR-1 was invisible continued to nag at astrophysicists, however. One's intuition would lead one to expect the reverse, that a star pouring out so much energy in X-radiation ought to be visible. With intuition in hand, a group at the Naval Research Laboratory took another look at SCO XR-1 during two rocket flights. Their data—an analysis of the spectrum using scintillation and Geiger counters—indicated that it might be visible as a faint star of the 13th magnitude.

The search was on. SCO XR-1's position was known to within one degree of arc in the sky near the galactic center. To make things interesting, there are about one hundred 13th magnitude stars in each square degree of SCO XR-1's neighborhood. SCO XR-1 was further pinpointed and its angular size found in a 1966 experiment by a group at American Science and Engineering. The group used a modulation—or shadow—collimator, which is shown schematically in Fig. 5. To reach the detector, X rays must travel through two sets of wires arranged in parallel planes. If the source is indeed a point source, its parallel rays will cast shadows of the front wires as well as of the rear wires on the detector plane. If, on the other hand, the source has a finite size, the rays will not be parallel and only the rear wires will cast shadows as in Fig. 5b. Experimentally, it was found in this way that the angular size of the X-ray source was less than 20 seconds of arc, the limiting resolution of the instrument.

One collimator is not sufficient to locate the source for it could lie in any one of the various directions that X rays can pass through to the detector between wires. This ambiguity was resolved by using two collimators with slightly different band separations. The source was in this way localized to a part of the sky where there were only two visible objects that might possibly be SCO XR-1.

Given the position of the two candidates, the Tokyo Astronomical Observatory and the Mount Wilson and Palomar Observatories began checking their visible spectra to find the one which was consistent with the known X-ray spectrum. Within a week, the source was found and verified. SCO XR-1 is a blue 13th magnitude star about 1,000 light-years away. It turns out that SCO XR-1 was first photographed in 1896, and its average brightness has not changed over the intervening years. But the star is variable over short times; it fluctuates in visual brightness by as much as a magnitude a day.

In summary, we have seen that the Crab Nebula is certainly not a neutron star because it spreads out over the sky. While SCO XR-1 is localized and might be a neutron star, this hypothesis is no longer widely held, and we shall see why



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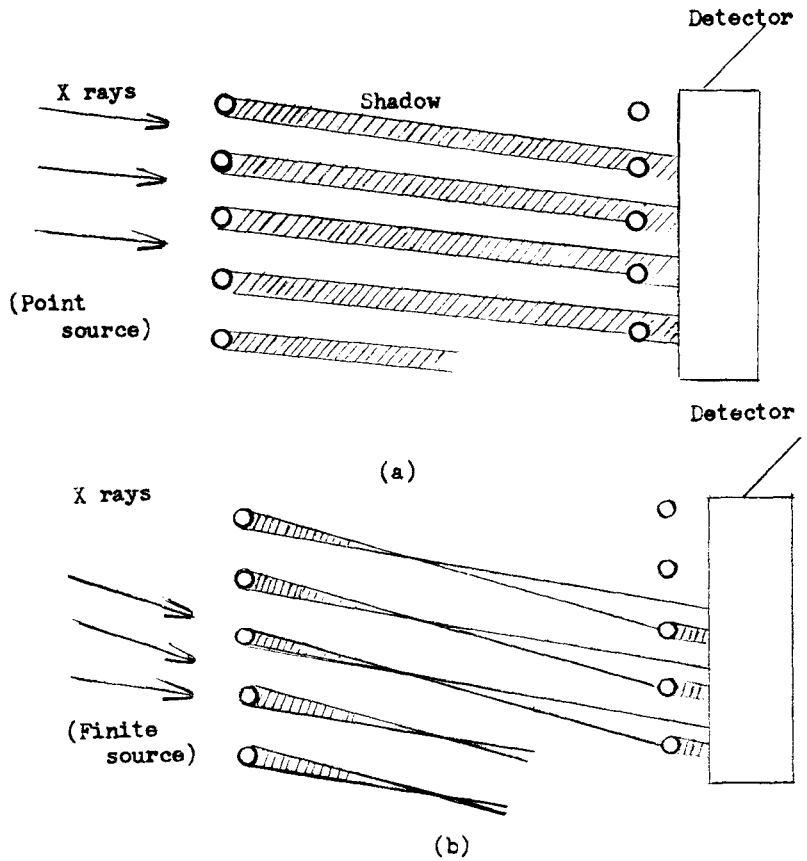


*Fig. 5. If, as in (a), a point source is emitting X rays, the front wires of the collimator will cast shadows on the plane of the rear wires. If, however, as in (b), the X rays are emanating from an object with an appreciable angular diameter, the effect is quite different.*

presently. There are several important differences in the two best-established sources. Interestingly enough, more X-ray sources seem to pattern themselves after SCO XR-1 than after the nebula source. SCO XR-1 is optically variable; the Crab Nebula source is not. The nebula source has a much harder X-ray spectrum than does the Scorpius source. And, the Crab



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Nebula—and presumably, its X-ray source—is definitely the result of a cataclysmic supernova burst. Astrophysicists are now looking hard at these differences, trying to understand the dynamics of the X-ray stars. Many are convinced that the X-radiation from these sources is so intense that it must play an important role in the history of the emitting object.

We are now going to discuss a number of possibilities that astrophysicists are mulling over. Not all of them are correct, perhaps none. Most suggestions advanced to explain the emission from both SCO XR-1 and the Crab Nebula involve radiation from either bremsstrahlung or synchrotron radiation, or both.

Both the Crab Nebula's radio and optical emission are polarized. Since this is consistent with synchrotron radiation, it is not hard to believe that the X-radiation might arise in the same fashion. The sticky thing about such an hypothesis is that relativistic electrons energetic enough to produce the observed X-radiation would lose their energy in less than 100 years by this process. This leads to some embarrassing questions. How has the 1,000-year-old Crab Nebula continued to generate X rays? How can other supernova remnants, with lives of 10,000 years, possibly emit X rays? Is there some mechanism, or source, to replenish the electrons responsible for the X-radiation?

Another model suggests that the Crab Nebula X-ray source is made up of hot, but dilute, gases radiating primarily by bremsstrahlung. Heavy elements formed in the initial supernova explosion decay radioactively, giving off electrons with energies of 10 keV or more, which could then radiate X rays by the bremsstrahlung process. No one can say with any certainty what elements would be formed during the initial explosion. The presence of the heavy isotope Californium 254*—and its subsequent decay—would explain the initial reaction. Long-term radiation would require a heavy and hypothetical isotope with a half-life of about 1,000 years. Apparently, such an isotope is not unlikely. Many people believe, for example, that all elements, heavier than iron, are created in supernova explosions. The principal achievement of this model is that it correctly predicts the observed dimming of the Crab Nebula. But it also has its troubles: it predicts that X-radiation will last long after the lower energy optical and radio emissions have disappeared.

There are persons who believe it difficult, if not impossible, for the Crab Nebula X-ray source to live by nonthermal bremsstrahlung

*Californium 254 was discovered, incidentally, among the products of the first man-made fusion explosion at Bikini Atoll.



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alone. These astrophysicists turn to the so-called ripple phenomena. Wisps of brightness have sprung up near the nebula's center over the last fifty years, and these wisps ripple outward, growing all the while. A bright wisp may be as big as 0.2 light-years across and have a luminosity of about $10^{45}$ ergs.* Collisionless shocks, together with the ripple phenomena, may produce local hot spots in the nebula. All that is then needed to explain the observed X-radiation by bremsstrahlung, perhaps, is an electron density in these hot spots of $10^3$ $cm^{-3}$, which is not too unreasonable.

A last, and quite exciting possibility, is that a pulsar might be causing the nebula's X-ray source. The nebula has its own pulsar, and it is an unusual one. Its period is the shortest of any known pulsar's—0.033 seconds. It was identified because it pulses in radio, *and* in visible light, *and* in X rays. No other pulsar has behaved in this fashion. The amount of X-ray pulsation is about 10 percent of the total X-ray emission of the Crab Nebula source. It seems unlikely that the nebula should be sheltering two such diverse objects as a pulsar and an X-ray source, and that the two should be entirely unconnected. But what the connection is—or even if there is one—no one knows. It would be interesting, in 1973, when the moon again passes before the Crab Nebula to see if the *pulsing* component of the X-radiation turns off quickly.

Returning to SCO XR-1, there is the possibility that, if not a neutron star, it may be a star just now forming. Or, it may be an old nova, an old star which blew away its excess baggage of gas in a not-so-violent explosion. Evidence for this nova hypothesis comes from the strong and variable emission of the visible spectrum, which includes lines of hydrogen, ionized helium, and excitation lines of carbon, nitrogen, and oxygen, and which is similar to the spectra of old novae. As more data showing SCO XR-1's resemblance to an old nova has accumulated, the neutron star theory of X-ray sources has faded further and further into the background. True, there is no record of a strong nova outburst in the seventy years of SCO XR-1's life that astrophysicists have data for. But a recurrent nova outburst occurring in less than yearly intervals would not show up in the available data. Astrophysicists are thus coming to believe that, in SCO XR-1, they have an uncatalogued old nova.

If SCO XR-1 is an old star which has shed its skin, a high temperature would have been generated in this shedding, and, hence, radiation via thermal bremsstrahlung when high-energy electrons

*These wisps are evidence for a central energy source in the Crab Nebula.



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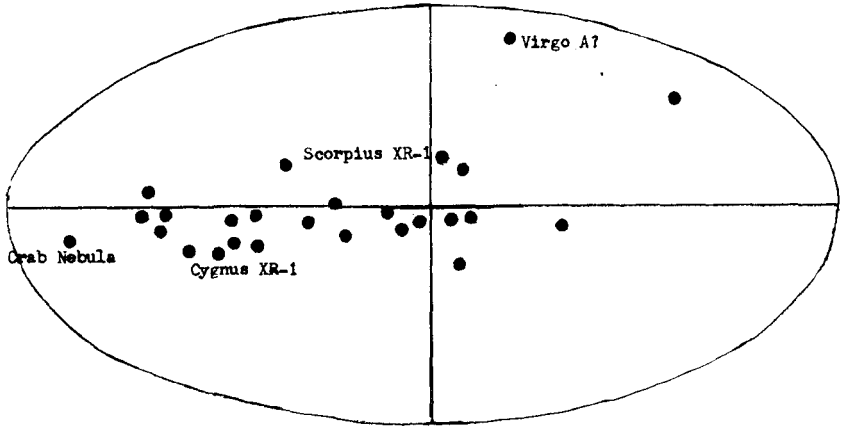
brake in colliding with positive ions. Astrophysicists have calculated that this is a possibility in a hot gas with a temperature of $5 \times 10^7$ degrees K and a mass about $10^{-5}$ that of the sun's. This hypothesis has only received half-




hearted acceptance, however. It explains neither the mechanism keeping the hot gas from expanding away out into space nor how the gas maintains its high temperature.

Another possibility is that X-ray stars may really form binary star systems. In this model, SCO XR-1 and its 13th magnitude optical counterpart would be two stars, rather than one star manifesting extreme ends of the spectrum. X rays would be generated through their mutual interaction. One of the stars in this binary system has condensed to form a dense star while the other star is just the opposite: a large star of low density. The large star expels large masses of material during flares, or surface explosions, which then plunge into the gravitational range of the dense star. X rays result when electrons, accelerated in their fall, bump into ions in the dense star. This is again bremsstrahlung. One nice thing about a binary star model is that it may go a long way toward explaining the variability of some of the X-ray sources. For, if the binary model is oriented so that the orbital

*Fig. 6. Some of the better established X-ray stars are shown here, most of which lie along the galaxy's equator. Only two have been optically identified, SCO XR-1 and the Crab Nebula source.*



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plane is in the line of sight, eclipses and, subsequently, X-ray fluctuations should occur.

We have discussed only two of the X-ray sources in detail, but presumably the other 40-odd X-ray stars emit X rays in similar ways. None of them, however, can be associated with a radio or optical object with any degree of confidence. Moreover, they do not seem to be at all alike; their spectra are different as are their intensities. The weakest source found so far has an X-ray emission about a hundredth that of SCO XR-1's. Only a few general conclusions can be drawn from the sources as a whole. Most of the X-ray stars lie close to the galactic equator—as shown in Fig. 6—which leads to the general belief that most must belong to our galaxy. Their locations seem to coincide with hydrogen clouds, the birthplaces of stars in our galaxy.

In addition to the Crab Nebula, at least two other galactic supernova remnants are probably harboring X-ray sources, Cas A—in Cassiopeia—and SN 1572—Tycho Brahe. Another X-ray source lies in the direction of galaxy M87, or the Jet Nebula in the Virgo Supercluster, and this is possibly an *extragalactic* X-ray source. If true, this source is emitting X-radiation at a rate comparable to the total luminosity of our galaxy! There is even some interesting speculation that quasar 3C 273 may also be an X-ray source. This would only be a moderate surprise, however, for quasars are most peculiar creatures and have exhibited strong and variable fluctuations at most wavelengths.

The weak, but steady, background radiation, detected on all flights is yet another mystery. About the only thing for sure is that the generally accepted modes of generating X rays do not seem to apply here. Either these require drastic revision, or something new is responsible. Many persons currently feel that high-energy extragalactic cosmic rays are responsible for this isotropic radiation, acting through the inverse Compton effect. If so, a cosmic ray electron scattered by starlight would transfer about .01 percent of its energy to a photon with the optical photon becoming a more energetic X-ray photon. This is not unreasonable if the cosmic-ray density seen at the Earth penetrates all space.

Still another suggestion is that the background radiation owes its existence to the superposition of a large number of galactic sources. If there is an X-ray source in every galaxy which emits X rays at a rate equal to that of SCO XR-1, then the integrated X-ray flux from galaxies as far out as the Hubble radius does not quite add up to the observed flux. This picture changes, however, if one supposes that some galaxies have larger X-ray sources than ours, or that they have more



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of them. As indeed they might.

Another hypothesis—"interesting if true, and interesting if not"—is that the background X-radiation may somehow come from matter-antimatter collisions. Physicists have long been puzzled by the apparent lack of antimatter in the universe. If the universe is symmetrical—and physicists like to believe it is—then there should be as much antimatter as there is matter. Possibly, the background radiation comes about in this way. Photons are created when electrons meet their antiparticles, positrons. The newly-created photons would have energies of at least 510 keV—the rest mass of the electron. Such photons are sufficiently energetic so that they could be called gamma rays, rather than X rays. If such gamma rays are detected, they would, besides explaining the puzzling background X-radiation,* indicate that large concentrations of antimatter exist. But so far, no one has been able to prove there is *any* appreciable annihilation radiation at any energy.

However this background radiation may have come into being, we can perhaps use it to find evidence for a choice between the big-bang and steady-state cosmological models. Up until the late 1950s, there was little basis for making such a choice; about all we knew was that galaxies exist and the universe expands. All this has changed since the advent of X-ray astronomy and such strange objects as the quasars.

Briefly, the steady-state gospel of creation—according to Hermann Bondi, Thomas Gold, and Fred Hoyle—says that the universe had no beginning and shall have no end; it is continuously growing and expanding, time without end. On the other hand, the big-bang theory—first set down by a Belgian priest, Abbe Georges Lemaitre—says that the universe arose from a "singularity"—or, "primordial Egg"—and that its expansion began at that point under conditions of extreme density and pressure. If the background X-radiation does consist of X rays created simultaneously with the universe, then it is, as mentioned earlier, evidence for a big-bang theory of the origin of the universe.

After the big bang, the universe could go two routes; it could expand indefinitely, or it could alternatively expand and then contract like an accordion. A model of this second sort is the oscillating universe model, and it can perhaps be tested by X-ray astronomy. According to this model, the universe is now in the process of exploding. If there is enough mass, and hence enough gravitational attraction, it can eventually collapse back.

*To account for the observed background radiation, one would have to have a way of degrading these large photon energies. This can, for example, be done by Compton scattering.



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Counting the visible stars and adding up their masses does not give a large enough total mass to support this theory. There must be a large amount of "missing mass" if this theory, which is accepted by many as a matter of religious conviction, is correct. With X-ray astronomy, it may be possible to figure out the density of the interstellar gas in our galaxy, and, perhaps with an extragalactic X-ray source—a lighthouse in space—in the rest of the universe as well. As the X rays become harder, the gas becomes more transparent; i.e., the more energetic X rays have a better chance of getting through the gas. By studying the spectrum as a function of wavelength, an estimate of the interstellar gas density can be made. This would indicate whether missing mass is indeed lurking in the interstellar gas. Yet another possibility is that stars which are visible only through their X-ray emission are harboring this extra mass.

Thus far, a steady-state theory of the universe has not profited by X-ray astronomy's probes. The New Astronomy may, in fact, have dealt a death blow to the steady-state, hot-universe model, which explains both the condensation of galaxies and the expansion of the universe. A long-standing cosmological dilemma is that local gravitational condensation would be inhibited by the energy needed to maintain universal expansion against the force of gravity. To sidestep this, the hot universe model says galaxies condense by local cooling in a hot intergalactic gas, gravity taking over when the gas reaches a certain threshold density. The intergalactic gas must have a billion-degree temperature in this model. The temperature is generated when spontaneously-created neutrons decay into protons and electrons with X rays being emitted when the high-energy electrons collide with intergalactic protons. The model predicts an X-ray flux about ten times higher than that seen, and this is its shortcoming.

At this point, the observations of X-ray astronomy, as far as they concern cosmology, are inconclusive. The two key numbers needed to resolve the question of how our universe evolved are those giving the universe's rate of expansion and the deceleration in the expansion. These are numbers which X-ray astronomy can help provide.

While X-ray astronomy has been moving ahead at a rapid pace, it has been hampered by a lack of proper instruments and observation time. From 1962 to 1967, only 150 hours of data were collected—one hour from rockets, the rest from high-altitude balloons. These data, moreover, were assembled with primitive and unspecialized instruments, borrowed from the art of nuclear physics.



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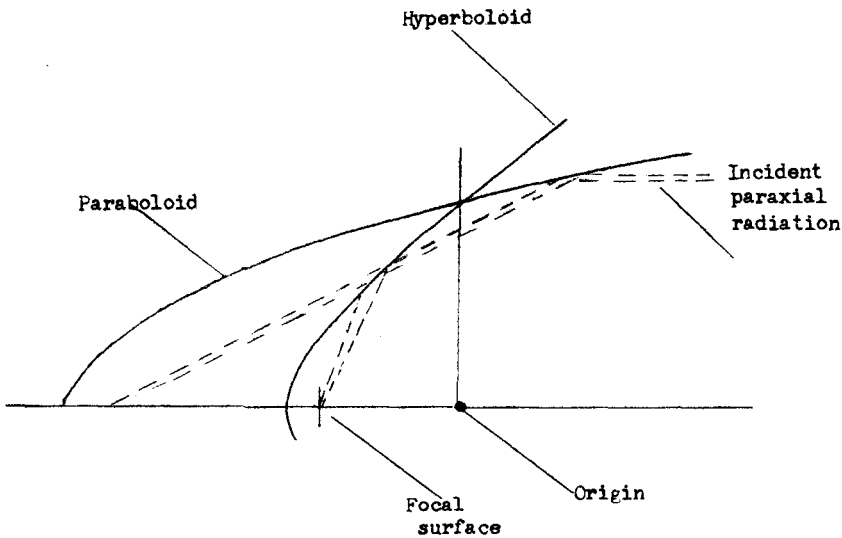


*Fig. 7. Grazing incidence telescopes make use of the fact that X rays act like light rays if they strike surfaces at a shallow enough angle. Here, X rays are focused by striking first a parabolic and then a hyperbolic surface.*

Today's telescopes would be able to identify X-ray stars $10^5$ times fainter than SCO XR-1 and locate them to within a few arc seconds, as well as identifying diffuse sources a thousand times weaker than the Crab Nebula source. This is not good enough for extragalactic astronomy, however, for even if a SCO XR-1 type source is located in Andromeda, the nearest spiral galaxy resembling our own, it is still impossible to say where in Andromeda it is. Thus, it is possible to make general statements about X-ray galaxies, but it is difficult to talk about individual X-ray stars in any galaxy but our own with any authority. (And this sometimes is hard.) Moreover, it is impossible to study the X-ray emission of *ordinary* stars in our galaxy, such as the sun.

Radio astronomy did not blossom as a science until about 1950 when radio telescopes became sophisticated enough so that astronomers could optically identify radio sources. Only now are telescopes of a comparable quality under development for X-ray astronomy. The whole new field of



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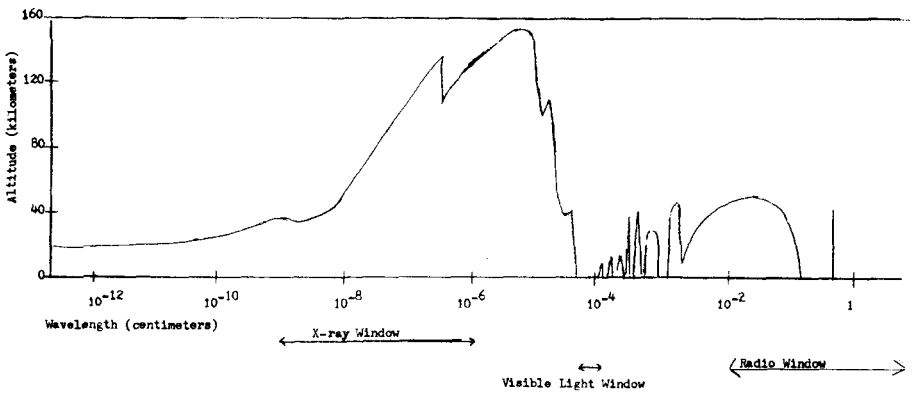
grazing incidence optics, which has sprung up as a technological offshoot of X-ray astronomy, holds exciting possibilities for the future. With grazing incidence telescopes, astrophysicists hope to be able to study X-radiation from a few to a hundred angstroms in the same detail as visible objects are now probed by conventional telescopes.

Grazing incidence telescopes exploit the principle of total external reflection. Despite their short wavelengths, X rays behave like light rays if they strike surfaces at a sufficiently shallow angle. X rays are thus focused first on a parabolic surface, and, following this, on a hyperbolic surface, as in Fig. 7. A grazing incidence telescope was first used in 1965 when the sun was photographed with a resolution of about one arc minute. This telescope was small: it was only three inches in diameter and had but a square centimeter of collecting area.

Grazing incidence telescopes have got considerably better since 1965, and they are now beginning to be used to study X-ray stars. One day, no doubt, huge orbiting X-ray telescopes with a fraction of an arc second resolution will be a reality. Since resolution is tied to wavelength, these telescopes could yield images 500 times clearer than those photographed with optical telescopes. With the advent of such high resolution, many celestial objects will be investigated for the very first time. Who knows what surprises this will bring? ■

*Fig. 8. The windows in the Earth's atmosphere are shown here as a function of altitude above the Earth's surface. The curve steepens at X ray wavelengths and peaks in the ultraviolet.*



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# THE OPERATOR

*In a harsh environment, you find tough organisms. In a really savage environment, the only ones left are also smart!*

CHRISTOPHER ANVIL

*Illustrated by George Wilson*

The rats and greevils were gnawing in their burrows as Jim Fielding, his teeth chattering, joined Dave Hunsacker at the cast-iron stove.

"Shove over," said Fielding. "Don't hog the whole thing."

Hunsacker coughed, and spat phlegm in a basin on a high split-log stool. He shifted grips on the pole that ran crosswise of the cabin, and rested his head on his hands as the blessed heat flowed up from the stove. From near his ear, came a *sqrueek-creeq-greak* noise that set his teeth on edge.

"Damn the pests," he growled, and was sorry he'd spoken. His voice came out in a half-whisper that reminded him how he felt.

Fielding drew a shuddering breath, and murmured, "Thank God we've finally got a foundry, anyway. We needed this stove, and the freight by supply ship would have sunk us."

Hunsacker, afraid to try his voice again, gave a grunt of assent.

"Snow's melting out there," said Fielding. "The air can't be below freezing, can it?"

"Unh," said Hunsacker, turning to get the heat from another angle. It was impossible to get enough, but too much would make his skin

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tender, even though too much wasn't enough, either.

"Well," said Fielding, "I had on my fur boots, wool socks under that, long johns, fleece undervest, fur vest, and fur jacket, long fur leggings, two wool hoods and a fur hat, and I was shaking all over before I got halfway to Pete's. Seemed like around forty below to me. There wasn't any wind, either."

Hunsacker grunted, and with an effort cleared his throat. "While you were at it, you should have heated a stone—put it in your pocket."

"You're right. I didn't think of it."

"How's Pete?"

"He's got it, too."

"Bad?"

"He says it's nothing. You know Pete. He was shaking too bad to go out to his woodpile. I carried in enough to last him through tomorrow. I think that's where I got this headache."

"He should have got a stove. He can't keep that fireplace in wood."

"He claims you can put in bigger pieces."

"How far did you go?"

"Out to the overlook."

"No wonder you're shaking."

"That isn't any distance."

"It is when you've got the grakes. Ease back, you've taken half the space already."

"Sorry. Well, I was curious."

Hunsacker roasted some more, then Fielding's last comment penetrated to his consciousness. It reminded him of a little quirk in his friend's makeup.

Hunsacker cleared his throat again. "Curious about *what?*"

"Unh?" said Fielding. He changed position and swore. "Do we have to stand and bake like lizards on rocks? I've got work to do."

"Go do it, then. Before you leave, what was it you were curious about?"

"I just saw it out of the corner of my eye."

Hunsacker waited. Fielding said no more. Hunsacker swore mentally, but saved his vocal cords for harder work.

"Saw *what* out of the corner of your eye?"

"That was just after I left Terrill's."

"After you *left* Terrill's."

"Yeah."

"I didn't know you *stopped* at Terrill's."

"Abe was having a fight with his wife."

Hunsacker started to turn his head, but a hammering headache burst into consciousness. He coughed, and spat up a quantity of phlegm. Then he had to blow his nose. He put his head back in place, eyes shut, and the *greak-sqrueek-creeq-sqreek* noise came through clearly.

"You stopped at Terrill's?" said Hunsacker.

"Not for long. Abe and his wife



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were embarrassed. Thought I might have overheard them." Fielding snorted. "You could have heard them half-a-mile away. One of the logs of their cabin powdered, a bunch of pack-badgers came in while they were asleep, and got into their stores."

*Greak-sqreek,* went the greevils by Hunsacker's ear, *sqrueek-greak,* as they reduced the hard wood to tunnels of dust. From a corner of the room came a *grak-grak-grak* noise as a rat ate its way along the join of the log.

Hunsacker shivered, started to speak, then concentrated on a more important fact: He had started to shake, despite the fact that he was practically on top of the stove.

He worked the leather glove from the hip pocket of his leggings, opened his eyes cautiously, and crouched, to turn the stove-door handle, and look in. He was greeted by a white powdering of ash over a bed of glowing coals. He reached out to the stack of dry wood heaped against the wall, selected some small pieces, put them in side-by-side on the coals, laid others crosswise atop them, and put some medium-sized pieces on top of that.

Fielding murmured, "Heat seems to be letting up. What kind of apprentice fireman we got, anyway?"

"I've been too busy trying to find out what it was you saw after you left Terrill's."

"Didn't I mention that? There is some kind of camp down there."

Hunsacker growled, "Down *where?*"

"You can see it from the overlook."

Hunsacker noted the small flames spurting from the smaller pieces laid atop the coals, and shut the stove door. Cautiously, he straightened.

Fielding said, "Watch it!" and steadied Hunsacker by the elbow.

A spell of reeling dizziness passed over.

"Thanks." Hunsacker got his grip on the pole, waited a moment, and said, "How come you saw something from Terrill's that led you to go to the overlook? Terrill's is a half-mile this side, anyway, with big woods in between."

Fielding's manner was carefully offhand.

"There was a girl looking down from the trail when I came out of Terrill's."

Hunsacker didn't move.

*Greak-sqrueek* went the greevils in the pole by his ear.

"A girl," said Hunsacker cautiously.

"Yeah. Just at the head of the trail, where it bends downhill. She turned when I came out, and went back into the woods."

Methodically, Hunsacker considered whether Fielding might be a lot sicker than he seemed. But, in that case, he wouldn't have made it back.

Fielding cleared his throat. "She



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was wearing some kind of form-fitting one-piece outfit, with a . . . like a bubble over it. I stared at her, and took a step in that direction. Well, you see the picture. I had on all that fur and leather, and some of it isn't exactly in the best of condition. Anway, she got out of there. Pretty little thing."

Fielding's voice thickened slightly, and he coughed and spat, and was silent.

Hunsacker asked himself whether his friend had gone stumbling and shouting after her. It would be interesting to go out and check the tracks—if he dared to leave the stove.

Fielding, apparently realizing the mental picture he had created, said, "I already had the shakes. Terrill's cabin was cold as ice; worse than outdoors, because the sun hadn't warmed it up. I plodded after the girl, but I tell you, I didn't rush. I was too busy checking to see if the trees kept their shape. I thought maybe I'd gone through the fever and hit the delirium ahead of schedule."

"Did you see her again?"

"Not once. Her tracks were funny, too—as if she walked *on* the snow. But of course it was too soft to support her weight."

"Not in the woods, necessarily. Where the sun didn't hit it, it might still be hard—provided it was compacted to start with."

"Then this wasn't compacted too much, because I went right through it."

"When she turned away, did she have any kind of pack on?"

"I don't know. She turned out of the sun into the shade, and I'd just come out of Terrill's so I didn't see that any too clearly."

"Did you tell Terrill about it?"

Fielding snorted.

"What for? He's *got* a woman."

Hunsacker considered the situation. Since the pack-bears had got Barrow, Hunsacker was theoretically the settlement's leader. The fact was occasionally acknowledged when a colonist, stuck with a problem he couldn't work out himself, brought it to Hunsacker. There was also an occasional deference, or an air of defiance, traceable to the fact that in a vague kind of way Hunsacker represented authority. To try to assert the authority would have been too ludicrous to think about, but nevertheless it imposed on him some obligations.

"Where she comes from," he said carefully, "that may not matter."

"It matters to me. That's what I care about."

"I mean," said Hunsacker warily, "this woman may represent as much of a threat to us as anything else."

Fielding started to object, then gave a grunt of assent. "Could be. Pretty, though."

"Could you see the camp from the overlook?"



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"Easy. Just the ship, and two tents maybe fifty feet from its base. They were small tents."

"What kind of ship?"

"One of these base-standers. I guess they call it a yacht."

"Any hatch open in it?"

"Not that I could see from where I stood. I was shaking too bad to think about going around to the other side. This camp was down in that big clearing below the overlook. Not the one at a distance, but right below."

Hunsacker cleared his throat. "Nice spot. The pack-bears hole up for the winter at the base of the bluff."

"Sure. When the melt hits, they'll come out."

"And they'll be famished."

"Right. That makes it nice when they smell flesh."

Hunsacker thought it over. Obviously, he had yet to extract the full story from Fielding. He spat phlegm, and eased his head around into a position that served to minimize the headache.

"What happened when you looked down on this camp?"

"Nothing, at first. I was shaking all over, thinking about this spot they'd picked to camp in, when one of the tents opened up. Another girl, wearing some kind of skimpy two-piece outfit, came out, saw me, went back in for a second, came out, and knocked about a quarter-ton of caked snow out of the trees onto my head."

"You mean she fired at you?"

"At me, or over me. I didn't stick around to make sure."

Hunsacker considered it from various angles.

"So there are *two* girls?"

Fielding said dryly, "That's the only reason I'm telling *you* about this, friend."

"What did the second one look like?"

"Beautiful. The first was pretty, so far as you can judge at a glance. The second was beautiful, so far as you can tell in one brief look."

"You saw her *twice.*"

"I'm not talking about the second time. Anybody that fires at me is ugly. I figure you can have the second one, and I'll take the first one. Just as a rough start to the negotiations."

"See any men around?"

"Nope."

"Anything we might decide, these girls could chop into mincemeat."

"I know that. We found *that* out back before the pox."

"We were green. Spoiled by civilization, and didn't know it."

*Sqrueek-greak* went the greevils at Hunsacker's ear, as if adding their bit to the conversation.

"What," said Hunsacker, to get his mind off his memories, "were Terrill and his wife fighting about?"

"About which one was responsible for the pack-badgers getting



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in. That was the standby. They threw all kinds of other stuff in, too. You could hear them way down the trail. They should have treenailed some sticks and leather over that hole first, and stuffed some hay inside, and they could have had the fight in private. As it was, their voices came right out the opening. Their kids were crying, and she was grabbing up this one and that one, and telling them to look at their father and see who was responsible for their being stuck in this godforsaken place, and he was telling her to shut up, he could only take so much, and one of them was smashing up furniture—there's another of those logs they better take a look at, because when they hit it, dust spurted out onto the snow. Anyway, they put things together fast when I came up coughing and clearing my throat. When they opened up, the place looked about as neat as any." Fielding paused, then added, "If they'd fixed that log first, they probably wouldn't have *had* a fight. The sight of that would drive anyone nuts."

"Probably so cold in there from that hole that they didn't get up to start the fire, so the kids started whimpering, and then they found the hole, and the provisions missing, and that did it."

"Whatever started it, they've got the fight to add to what the badgers did. It's a simple question of survival to avoid that."

"You think back before the pox, and tell me how many of us avoided it."

"Not many. And a lot didn't survive, either."

Hunsacker again struggled to get off the subject.

"Both of these girls had on bubble outfits, eh?"

"The first one did. I could see it reflect—glint—in the sun. The second one I don't know about. Why?"

"Unless they've changed them since we've been out here, there's just a thin plastic layer filled with warm air by a backpack heater. That's fine as long as the plastic is all right. But what happens if she steps too close to a needle bush?"

"Rip the plastic."

"And the only protection under this bubble was a little thin cloth?"

Fielding grinned. "Protection? Decoration."

The stove suddenly popped and snapped as the wood caught.

Hunsacker nodded sourly.

"Green. They're as green as we were when we got here, maybe worse. They've paid their money for some dude-camping outfit, and they think they're as safe as in a park on their home planet. Meanwhile, they're going around eighty percent naked on a part of the planet where the women have been cut by a third for two years; but, of course, they're enlightened, so *that* doesn't matter. Those two girls could be the worst disaster to hit this place since the pox."



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That night, after the fire had been left to gnaw its way through the big dry chunk he had worked in atop the coals, Dave Hunsacker lay awake, lying on his side, the packbear robe and a down comforter over him, and heat flowing around him from the cloth-wrapped rock at his feet, and the cloth-wrapped rock that he lay curled around. Despite the heat, he shivered involuntarily, but that didn't stop his thoughts.

Two girls camped alone on the packbear flats. Two girls from *civilization*. Two girls who fired on crude unkempt colonists, or fled at the sight of them. Then weird pictures began to flit before his eyes, so he knew the delirium had started. Across the room, he could hear the frame of Fielding's bunk rattle, and knew that he had it even worse. After all that exposure, the grakes would speed up, and Fielding would go through the whole sequence in a day and a night, where Hunsacker had done his best to stretch the thing out for two days. It wasn't the headache, the shaking, and the chills that bothered him the worst. It was the delirium. It had a tendency to focus on some strong emotional experience, and stay with it, to work variations and contrasts that became so intense as to threaten a man's power of endurance. Afterward, the memory faded, which was fine afterward, but no consolation beforehand. Hunsacker held his mind on the two girls, struggling to make the delirium take some new track, to force it to yield him pictures of the packbear flats, or Terrill's cabin, from which Fielding had seen the first girl.

Just then, the picture came clear. The low fern tree, green against the white of the snow, and green against the grayish brown of the slightly weathered logs, sifted down snow as the wind blew around Terrill's, and Lila Terrill, her pretty face framed in the white fur hood, called out, "Dave! Lou! Hey, don't you dare go by until you see this slinky new fur outfit Abe made for me!" She laughed, and breathed out a cloud of frosty breath. "Oh, isn't everything wonderful" Eyes sparkling, she looked up at the trees, at the sky bright-blue through the green branches edged in white, at the white snowflakes drifting gently down. "And they told us we were crazy to risk a new planet! *They* were the crazy ones!"

The scene vanished.

The lump of dirt landed on Lou's upturned face, the spots half-hidden by the flour she used to conceal from Dave the fact that she had it, so that he would let her go on working with him as the cold settled its teeth in and the fireplace sucked the cold through every track where the pack badgers nightly dug out the clay in search of a gap big enough to get through.

"There is no help available,"



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crackled the communicator, and the voice came through clear and sharp. "We can't risk personnel. We suggest that you simply avoid exposure, rest in bed in a warm room, avoid all exertion, take frequent hot, sweet, citrus drinks, and see to it that the patients have plenty of fresh air and sunshine, but are not directly exposed to the cold. A steam or electrically heated solar shelter will be ideal. Regular records of body temperature, taken orally, should be kept for future reference, and—"

The snow blasted through the hole where the window had been torn out, sifting down the slope of the drift like a fast-shifting living curtain, scattering across the floor, to be picked up and whirled around the cabin by the hurricane blast that came in under the door where he had shoveled it clear when the snow stopped yesterday, and the sun came out, and they knew the storm was over.

"Lou!" he cried, "why didn't you wake me up! You've got to rest!"

"You were so tired," she said. "You worked so hard yesterday."

Then the clump of dirt landed on Lou's upturned face, where she had put the flour to hide the fact that she was sick.

Abe Terrill said, "Lila's got it. I could see the spots yesterday. And now today she's got this awful cold, too. She shakes all the time, and I can't get it hot enough for her. I can't get through the snow to get the wood back fast enough. You and Jim have both lost . . . I mean, you're both *alone*. If you could move in together, and split the work, would it be all right if I took the extra wood you've got piled? I was so busy working on other things last fall I got behind cutting firewood. I never thought we could have a storm like this. I've got to get wood somehow! I'll carry it up myself. Look, it'll be good for you, too, it'll keep you from going crazy thinking about it, and the work will be lighter."

Hunsaker groaned and turned over, and his forearm touched a corner of the rock where his tossing had pulled the cloth away. He struggled out of the delirium.

"Lou?" he murmured, and there was no answer. He sat up in darkness dimly lit by moonlight. From across the cold cabin came racking sobs. But it was a man sobbing.

Hunsacker groped backwards and forward, trying to locate himself in time. The whole sequence mentally unreeled to the end, and he lay back, the pain as fresh and new as when it had happened. He shivered, and the snow whirled, and he looked dizzily around, resting the saw on the log.

Lou was there laughing.

"Come on," she said. "Stop cutting wood for a while. A little more, and you'll be a registered termite, just like we've got in our walls."



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"Did you ever see snow, woman? I want to cut wood now, while I can get it. And those aren't termites. They're greevils. Learn the *patois* of the planet if you want to communicate with me."

"Why should I communicate with a termite? Abe Terrill has time enough to make his wife a fur outfit, no less. Now, *that's* what I call adaptation to the environment."

The clump of dirt landed on Lou's upturned face. The bitter cold sapped his strength and made him regret every minute wasted in the pleasant days of fall, when the snow was a mere ornament.

Dave turned over, and the delirium shifted its grip, and came at him from a new angle, bringing a fresh memory before him as, across the dimly moonlit room, Jim Fielding cried out, and neither man heard the other.

Toward morning, it began to let up.

Dazed, Hunsacker struggled awake, to rest dizzily on his elbows amongst the tangled covers.

"Merciful God!" said Hunsacker.

The memories flooded his mind, and then at once began to fade.

From across the cabin, Fielding spoke in a croaking voice.

"You alive?"

"I guess so."

"That's the last time I concentrate it all in one day."

The memories of the delirium were evaporating fast, and suddenly Hunsacker felt quite ravenous.

"Pretty bad?" he said.

Fielding said grimly, "I got contrasts and ironies this time I never dreamed of before. There was even one—" He paused. "Good. I can't remember it."

"It's not dawn, but I'm getting up. You?"

"Yeah. I'd be afraid to go back to sleep after that. Besides, I'm a little hungry."

"You light the lamp. I'll take care of the fire."

"O.K."

Roughly two hours later, the sun was just casting shadows across the gray surface of the snow. Hunsacker and Fielding, heavily dressed against the cold, lay stretched out in the snow, looking down on the silent camp below the bluff.

"Late risers," murmured Fielding.

"Where they come from, this could be the middle of the night." Hunsacker eased slightly to his left, so that his gun, inside its long fur case, didn't press into his side.

"What's that?" murmured Fielding.

From down below came the faintly echoing sound of light footsteps crunching through the snow.

In the dim shadows, a small figure, heavily dressed, and carrying something large and long on its shoulders, came into sight at the edge of the clearing. There was a sound somewhat like sand dumped



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from a sack as the figure dropped what it was carrying, and it sank in grainy snow.

Fielding murmured, "What's that?"

"Looks like a log."

"Too big."

"Could be pithwood. That's light enough."

"I think you're right. What would they want with that stuff?"

The light, reaching into the woods, showed it more clearly, and Hunsacker corrected himself.

"*Rotten* pithwood."

"Maybe they know more than we *think*. You suppose they're planning to smoke out the bears?"

"Don't ask me. Which one is this?"

The two men watched the small figure, carrying what looked like a double-bitted ax in one hand, slowly start up a sloping slender ramp extruded from the yacht. The surface of the ramp was free of snow, but whoever it was slipped on stepping onto the ramp, and nearly fell.

Fielding murmured, "I *think* it's the one I saw first. Is that ax sheathed?"

"Not that I can see."

A beam of sunlight was now streaming through the trees, to light the tops of the tents, and the lower half of the yacht. The figure, wearily climbing the ramp, passed through the light, which flashed on the blades of the ax.

Fielding grunted. "Where she slipped, I could have lost my half of this bargain. What's she carrying the thing bare for?"

Hunsacker watched the girl lean the ax against the side of the ship while she felt in her pockets. The way she leaned the ax against the ship was to set the end of the ax handle on the sloping ramp, and rest the head of the upright ax against the side of the ship.

Fielding muttered to himself.

She paid no further attention to the ax, but paused to blow on her cupped hands and work her fingers. Again she felt through her pockets.

She stamped her feet, as if to start the circulation.

The ax head began to slide, along the hull of the ship, picked up speed, then the ax flipped over the side of the ramp, to vanish in the snow below.

Fielding let his breath out with a hiss.

She had some kind of small box in her hand now. She turned an intensely bright light on the side of the ship, then held something cylindrical against the ship. A sizable door slowly opened out at the head of the ramp, the door swinging wide against the ship.

The girl started slowly in, paused, came back, looked blankly around on the ramp, looked at the door, and then turned wearily and went inside. As the door started to close, a feminine voice called, "Where have *you* been?"

"Lost."



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The door shut, and Fielding uttered pungent profanity.

Hunsacker rested his head on his forearm, and shook with silent laughter.

"Lost," growled Fielding. He stared at the track lit in the snow by the sun, and that was bound to be visible by the girl's handlamp, or by moonlight.

"Well," growled Fielding, "I guess they *don't* know what they're doing."

"Probably panicked," said Hunsacker, keeping his voice low. He paused, studying the tents.

A faint vibration sent a very light powdering of snow sifting down the slope of the nearer tent. Some sort of fastening in the front opened up, and a tall girl wearing, apparently, a two-piece bathing suit, stepped out and looked around. She sent an intent glance over the heads of the two men, who lay motionless in the confusion of light and shade.

"That one," growled Fielding, "is yours. But now, this totals up to *three*."

The girl turned away, and saw the log.

"Good! Phyl *did* get some wood!"

A shapely blond girl looked out of the tent, and gave a scream of delight. "Now we can have a cookout!"

"Four," grunted Fielding.

There was a drumming sound, and snow flew from the other tent. Gales of girlish laughter echoed around the clearing. Two more girls burst out and rolled in the snow, pounding each other with handfuls of snow. The laughter abruptly changed to cries of dismay.

"Oh! It's *cold!* Stop, Stacey. Please stop."

These latest two plunged through the snow to the base of the ramp, and ran up, to bang on the side of the ship.

"Open up! We're *freezing!*"

Fielding growled, *"Six* of them."

"So far," said Hunsacker.

From somewhere down below came a whistle, then a masculine voice called, "Hey, *hey!*"

Fielding and Hunsacker, moving only their eyes, glanced around.

Floating over the clearing at the extreme end, from the direction of the more distant clearing, came a dish-shaped grav-skimmer, that now swooped forward, to hover over the ramp. In the grav-skimmer were four men in their early twenties. One was wearing a loincloth, one a kind of old-fashioned bathing suit, one a pair of green form-fitting trousers creased up the front, and imitation deerskin jacket fringed on the bottom and along the cuffs. One was wearing a set of brief silver trunks, and gold paint apparently intended to show off his large muscles.

The two girls on the ramp screamed in mock panic. One of



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them shouted, "The pirates are after us! Help!"

Fielding belched, and muttered profanity.

Hunsacker alertly studied the reactions of the girls, noting that the tall girl had an unreadable expression. The shapely blonde looking out of the tent went back inside without saying anything. The door of the ship opened, and a neat intelligent-looking brunette glanced out coolly, wearing what appeared to be some sort of dark lounging pajamas.

Hunsacker, still not moving his head, glanced back at the grav-skimmer, noting, as it idly turned, the snout of some kind of weapon that jutted up at an angle.

Fielding growled, "How much younger than us is this crew?"

"Four or five years, I think. Why?"

"For just a minute there, I felt about ninety years old."

On the grav-skimmer, the male figure wearing the breech clout pointed at the girl in the doorway of the space yacht. He half-crouched, and clapped his hand on his knee.

"Ha, ha, ha," he shouted, his voice creating a peculiar crowing sound that reverberated around the clearing. "Ha, ha, hee, hee, hee, ho-*ho*-ha. Look at that, fellers, a *lay* dee!"

The girl stepped inside and the two girls on the ramp ran in. The door swung shut.

From the direction of the other, more distant, clearing, came a loud croaking sound, rapidly repeated. A second grav-skimmer floated into view. This one carried five more men, two heavily dressed and silent, the other three dressed as for a masquerade. One of the latter called out jubilantly.

"Hey, we got fun later! This planet's got *col*onists!" He pronounced "colonists" with a peculiar jeering emphasis.

"*Col*onists," shouted one of the occupants of the first skimmer, mimicking the tone.

Hunsacker studied the angled gun on this second skimmer.

Fielding murmured, "This looks nice, doesn't it?"

"Doesn't it?" With no extra motion, Hunsacker undid the fastenings of his gun-cover.

"*Col*onists! *Colonists!*" the men were chanting in the clearing, with the exception of the silent two in the second skimmer.

The tall girl went back into her tent.

Hunsacker said, his voice low: "It looks to me as if that gun has a target-seeking sight—the gun on that skimmer turned toward us."

"I see it."

Hunsacker left the wrapper just covering his gun, and carefully pressed the carrying straps back out of reach in the snow, lest he forget and try to pick it up by the straps out of habit.

Down below, the chanting had



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reached a pitch and volume that strained the voices of the chanters. Their voices cracked, and then there was a sudden silence.

From somewhere came a low muffled questioning bark.

Hunsacker squinted at the sky. The sun, now above the horizon, was warming the snow-covered landscape with a burning heat that was undiluted by any cloud cover, wind, or really cold air. Down in the clearing below the bluff, the heat was bound to become more intense as the day went on, since the bluff would reflect the heat of the sun back into the clearing.

There was a soft *shush* of snow behind them, instantly followed by Terrill's voice, pitched low.

"It's me . . . Abe."

Hunsacker, who had tensed himself, relaxed at the familiar voice.

Terrill gave a low laugh. There were further *shush-shush* sounds, and he lay down full length, and crawled up beside Hunsacker.

"If I'd been a bear, I'd have eaten you both."

Fielding, his voice low, said, "Take a look at this gun, Abe, but keep your head down."

Terrill squirmed around, and gave a low fervent grunt.

Hunsacker glanced aside, to see Fielding flip the cover back over his gun. The gun was reversed inside its wrapping, the snout aiming back down the trail, the butt lightly depressed in the snow; a squeeze of the trigger would have sent the bullet waist-high over the place where the trail began to level out behind them.

Fielding murmured, "I hate things creeping up on me from behind."

Terrill murmured, "I was going to bear-bark at you for the fun of it. I'm glad I didn't follow *that* whim. What have we got here, anyway?"

Hunsacker said, "Take a look. Maybe you can tell us."

Fielding said, "It's a little hard to explain."

Terrill peered down at the clearing, where the two skimmers had set down, and the occupants, still standing in the skimmers, were talking to one another with expansive gestures. There seemed to be some kind of disagreement between those dressed as if for a masquerade, and the two wearing heavy winter clothing.

"Well," said the one wearing a heavy coat, "*you* do it if you want. Count me out."

"Scared? Of washouts?"

"I keep seeing that woman's face when she picked up the baby. She looked straight at me."

"So what?"

"I'm not getting in that spot again."

"That was an accident."

"I'm not getting in a spot where that accident can happen again."

"That baby would have died anyway."

"How do *you* know?"



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"Colonist mortality is better than eighty percent."

"That's overall. We don't know about *that* baby."

"What's the difference? They don't relate. They're out of the socioeconomic system. They're washouts. Hell, they're only human by courtesy. We don't have to worry about what happens to them."

"It's all yours. I don't get anything out of it but nightmares."

"It's like if you crack up anything. You want to do it again right away. That makes it all right."

"Not me. That woman said something with her eyes, and I can't forget it."

"We *could* take you, whether you want to go or not. We could . . . kind of . . . make you do it, whether you want to do it or not."

There was an ugly silence, then the first voice carried, very low.

"*You'll* make me?"

The silence stretched out, then broke in a nervous laugh.

"I was just kidding, Barn. But—"

"I'm not going."

"O.K. So, O.K."

"Hack feels the same way. We both aren't going. We all agreed before we came, we wouldn't tell each other what to do. We're sticking by it."

"O.K., Barn. I was just kidding. Look, here we are arguing about *what?* A bunch of mudfeet. You do what you want. But there're nine of us, and only eight girls. So how do we work that out?"

"Leave it up to the girls. They'll figure it out some way."

"O.K., Barn. Hey, who's got the battlewagons?"

The collision broke up in nervous laughter, and shouts of, "Who's got the battlewagons?" Someone began handing out something too small to make out as they milled around in the two skimmers, bending over to pick up small pipes with curved stems and small bowls, into which they put whatever it was that had been handed out, and then lit the pipes.

From somewhere came a gruff peremptory questioning bark, muffled but insistent, with overtones of ill temper.

Terrill murmured, "The damned fools are in the middle of packbear flats, and it's a warm day."

Fielding looked around at Hunsacker and murmured, "Well, Dave, what do we do?"

Hunsacker kept his mouth shut.

Terrill twisted toward him, to murmur, "You're the Settlement Leader, Dave."

Hunsacker growled, "Where's the problem?"

Fielding murmured, "We need women, and there are *eight* of them. Right under us in the bluff, there's a whole pack of bears, and you can hear the sentinels getting short-tempered. When the day gets warmer, those packbears will come out. They'll eat anything in sight,



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plant or animal. When they come out, they'll spot the girls."

Hunsacker grunted. "They've got their protectors down there. Look at the armament on those skimmers."

"Will it stop a rushing bear?"

"How would I know if it will stop him? But it will *kill* him."

"What do we do about the girls?"

Terrill put in, "A few well-placed shots while that bunch is doping themselves up, and we will end the thing."

"Don't kid yourself," said Hunsacker. "The racket from a few well-placed shots will bring those bears out of there in a rage. On top of that, that yacht probably has an automatic device recording—and maybe broadcasting to a satellite—everything that happens around it. And, on top of *that*, what do the girls do while we're picking off this bunch?"

Terrill said, "Where *are* these girls you're talking about? I don't see any girls."

Fielding said, "There are two of them in that tent nearer to the ship. And from what's been said, there must be half-a-dozen more in the ship. We've only seen four of those."

"Good lookers?"

"What?"

"Are the girls pretty?"

"Yes, but green."

"They'll get over that."

"Say," said Fielding in a low drawl, "I thought you were married."

Terrill didn't answer for a moment. "I was thinking of Pete. He's over at our place helping out so much lately, I . . . well, I'm glad to see some more women around here."

Hunsacker said dryly, his voice low, "I don't think they came here to settle."

Fielding said, "Well, what do we *do*, Dave?"

Hunsacker said nothing. He was still trying to fit the pieces together.

Terrill murmured, without conviction, "We could warn them about where they are."

Hunsacker squinted at the clearing.

"How?" said Fielding, his voice low and sarcastic.

"Stand up and yell to them."

Fielding growled, "I almost got my head split yesterday, because one of the *girls* saw me. We're supposed to warn *this* bunch?"

Down below, the men were sprawled in odd positions, in the skimmers and on blankets stretched on the snow, the sun now plainly glinting from the bubbles of their warm-suits. Each was drawing on his pipe, his face blissful, save for the one who'd been called Hack, who had a look of horror. The one wearing silver trunks and gilt, played with the controls of the gun with his toes, twitching his biceps and admiring it sidewise as he let smoke drift out his nose.



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"O.K.," said someone, his voice now strong and assured. "Now, I say, let's take a look at the local washouts."

Terrill said: "Where do they get this 'washout' business?"

"Give a dog a bad name," murmured Fielding, "and kill him."

Someone else spoke in the clearing, his voice flat. "And I say Hack and Barney Baby come with us. Or we break their heads."

"Yeah. Maybe *Barney* wants to be a washout. How about it, Barnhead?"

The cold voice answered, "Anybody wants to force me gets it in the guts. Who's first?"

"Yeah? Tough, huh? *Jump him*!"

Half-a-dozen of the masquerade figures sprang up, and a violent struggle began.

Hunsacker watched intently, his mind a maze of calculations.

Fielding growled, "Do we stand by while this goes on?"

Just then, it all fit together. Hunsacker growled, "Spread out to either side, and stay *low*. Don't fire until they shoot first, then aim to get any at those guns. I think those are automatic guns. If the bears come out, kill any that start toward that tent nearest the ship."

Terrill and Fielding wormed backwards, and eased rapidly to either side.

Hunsacker studied the scene below.

The flailing knot was still struggling. "Barney" was plainly putting up a formidable resistance, and now "Hack," throwing the pipe away, stood up.

The gilded figure by the gun breathed out a cloud of smoke, and came easily to his feet, swaying slightly. He reached out, gripped Hack around the throat, and jerked him backwards.

Hunsacker wormed sidewise, leaving his gun where it was, and stood up, unarmed.

He shouted, "You down there! Look up! Look up here!"

From somewhere in the bluff below him came a short-tempered muffled ugly bark.

Up off the snow, the day felt hot already, and a current of heated air seemed to be rising up the face of the bluff.

Studying the guns on the skimmers, Hunsacker was sure now they were automatic.

"Hey!" shouted someone below. "A *mudfoot*!"

"Look, a *col*onist!"

Hunsacker, without turning his head, glanced sidewise, to fix the location of his gun.

The gilded figure dropped the motionless Hack, stood up, faced the bluff, and flexed his muscles.

Barney, staggering to his feet as the others turned, stood breathing fast and deeply.

The door of the space yacht started to come open, and then shut again.



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Hunsacker instantly shouted, "I want to warn you! You're in danger!"

"*You're* in danger, washout!"

Hunsacker kept his mind on what he had to do.

"I'm in no danger here. You've landed in the wrong place! *Listen* to me!"

Barney was now breathing a little more evenly.

"Listen to the guy," he said. "He's trying to tell you something." His voice was low, and his words came out between breaths. As he spoke, he was looking directly at Hunsacker, his gaze intense.

Hunsacker seemed to catch some significance in the look, and without conscious intent, his glance as he looked back showed approval.

One of the masquerade figures glanced around to say jeeringly, "You don't sound so tough, any more, Barnhead. Better start doubling up on the wagons. O.K., *gun the slob down*!"

The heat rising up the face of the bluff made Hunsacker, in his heavy furs, almost faint. He noted the masquerade figures diving for the guns of the skimmers, saw Barney plant his booted foot in the belly of the gilded giant, and then Hunsacker dove for cover.

There was a sizzling *crack* like a lightning bolt passing over his head, and then the heavy double *boom* as Fielding and Terrill opened up.

Hunsacker eased his gun out of its wrapping, aimed carefully, and fired from one side of a small low evergreen growing near the edge of the bluff. The roar of the gun all but deafened him as the charge, meant to throw a slug that could stop packbears, sledgehammered his shoulder through the heavy clothing.

Below, two of the opposition were down, but one of the two guns was swinging around by itself. Having been once aimed more or less correctly, it would seek the target, using heat and metal-detectors.

Hunsacker fired at the center of the detector.

There was a blinding flash, a deafening *crack*!

He lay dazed, vaguely conscious that that one had been meant for him alone.

He seemed to spiral through a kind of blackness to see the night sky, and then later the blaze of sun on snow through his eyelids. He opened his eyes, and peered down. Through the dullness of deafened ears came what sounded like the squealing of many pigs.

Then the scene came into focus.

Huge bearlike forms eight to ten feet high at the shoulder, with teeth like daggers, boiled across the clearing directly into the murderous fire, reached the skimmers, to rip and smash and crush, and then fall dead. Behind them, more poured from the burrows. There was, as Hunsacker's hearing started to return, the hideous rumbling



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snort of famished packbears rending their prey.

Hunsacker felt in his pocket, and got out earplugs made of a corklike bark. He twisted the plugs into his ears, and then methodically began to pick off any bears that ambled away from the shambles toward the tent nearest the ship.

The bears, bloodied and snorting, looked around, and suddenly realized they were being hit from somewhere out of reach. With grunts and snorts, they surged across the clearing, in their haste gathering momentum in the direction that would normally have got them clear in the shortest possible time, but that now took them straight to where the space yacht stood.

With a series of clangs and crashes, the bears caromed off the yacht. One apparently stepped on the double-bitted ax under the snow. It let out a bellow of rage, tore a chunk of the outer metal off the ship, and waded into the complications within.

Hunsacker studied the guns on the skimmers warily. One was twisted into a pretzel. The other had the detector smashed, and wasn't moving. He got up cautiously. Nothing happened. He glanced around. Fielding and Terrill were out of sight, but holding their fire. Hunsacker glanced down the sheer face of the bluff. It was possible to go down that sheer drop. He had done it when they were first here. Alertly, he noted the tough-rooted fern bushes growing out here and there from crevices, little ledges, and invisible places of attachment. He looked again at the clearing below, where nothing now moved, looked again at the fern bushes, put his gun in its wrappings, put the earplugs in his pocket, and swung over the edge.

His whole perspective changed abruptly. Heat seemed to billow past him in waves. The clearing seemed a thousand feet below. The ledge above was a comforting nest of safety. The bluff was suddenly peopled with additional hibernating packbears that had yet to awaken, and were rousing themselves as he slipped and scrambled by, seizing the bushes, and working awkwardly but rapidly lower, as with ripping popping sounds the tough rootlets tore loose, and he shot past to the next handhold.

All he had to do, he knew, was to gather too much momentum, and he would plummet to the bottom and smash on the rock rubble piled at the base of the bluff, behind which the packbears had excavated their caves in the soft layer some twelve feet thick that was slantingly exposed to the weather there, and toward which Hunsacker seemed now to have been dropping forever, and yet getting no closer.

And then suddenly it was only



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three more slips and grabs, two more, one more—and with a thud and a desperate dance over the rocks and through the fern brush that sprouted up through them, he stumbled out into the clearing, to plunge awkwardly through the snow.

A cold feminine voice said, "Stop right there."

He tripped, went down in the snow, head first, and lay still for a few moments thinking through what he had planned, and finding it still solid and sound as far as he could make it solid and sound. Then he sat up, but did not rise. He would look more helpless sitting in the snow.

The taller of two girls, dressed in a skiing outfit that covered her from head to foot, sighted the rifle at him. The blond girl, also well covered, stood with her hand at her mouth beside the tall girl.

Dave said exasperatedly, "Why did you have to camp *here*? There are packbear dens at the base of that bluff, and for all you or I know, there are still a few hibernating bears in there just waking up." The likelihood of this was small, but it wouldn't hurt to mention it. "On top of that, once they quench their thirst, those bears are likely to be back here."

Her grip on the gun didn't waver. In a cold, deadly voice, she said, "You turned them on us."

Dave wondered uneasily just how shrewd this girl might be. But he allowed his face to show only indignation and the beginnings of anger.

"I *what*? Were you in that tent when they were snorting and rumbling around out here, or weren't you?"

She didn't answer, and she didn't shift her aim. The blond girl glanced at her nervously. Dave glanced at the blonde.

"Were you in the tent, or weren't you? Maybe I was wasting time picking the bears off when they got near the tent."

The blond girl swallowed, and glanced again at the tall girl with the gun.

Dave ignored the girl with the gun, and spoke to the blond girl, "Keep out of the line of fire. Don't get between your friend and me—but go take a look at some of those bears near the tent."

"I'm afraid."

"They won't hurt you. They never play dead. They either run, or fight to the finish. Go close enough to see their backs, and tell your friend if there isn't a hole blown through the fur at the base of each one of their necks."

The blond girl hesitated, glanced at the tall girl, glanced back at Dave, then turned, and waded through the snow toward the tent. The tall girl reluctantly lowered the gun, but continued to watch Dave with a look of cold alertness. Dave looked away at the



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base of the bluff, then searched the woods behind the battered yacht. The tall girl glanced up at the sky searchingly, and then sharply back at Dave.

The blond girl called, "He's telling the truth, Chloe. There's a lot of . . . of fur and flesh blown away at the backs of their necks."

The tall girl looked directly at Dave, the gun lowered but still ready.

"You turned them loose on us, and then killed the ones that went near the tent, in order to get rid . . . of—"

She glanced at the remains of bodies around the two skimmers.

Dave again wondered how shrewd this girl might be.

"*If* I had done that, I think I could make a case that it was in self-defense; but will you kindly tell me how I, or anyone else, could control these man-eaters?"

"They didn't hurt *you*."

"I wasn't there to be hurt."

She half-raised the gun.

"I saw you come out of there right behind them."

For an instant, Dave was left groping. Then it dawned on him that it was *not* pure shrewdness on her part that had led her to the right answer, but partly ignorance. She thought he had been in the caves with the bears, because she had seen him come from the same direction. Still, she seemed alert and intelligent.

He glanced up at the face of the bluff.

"Look at that bush, halfway down the bluff. See how it hangs off-center? Now look up at the top, almost above it, but at the top of the bluff. See where the snow is broken. It's smooth to either side, but just there it's broken. What do you suppose made that? Now, look down between those two places, and do you see how there's a slightly zigzag line of bushes at different slants—nearly every one pulled slightly out of line. There, below, near the bottom, there's one with a limb broken. The underside is lighter than the upper side. See how it's broken off? What do you suppose did that? Now, at the base of the bluff, I don't know if you can recognize it, but— No, too many bears have been through there. See, the top of that bush below the line down the face of the bluff. It's been broken. But I doubt, with all that trampling—"

"I see it," she said. She looked at him curiously, and glanced again at the sky. She looked back at him quickly, with a wondering look.

"Are you saying you *didn't* turn them loose on us?"

"I'm saying I was at the top of that bluff when they came out, and nothing you could give me, or pay me, would have put me inside those dens with them. Do you know what it would be like in there? You seem to think they're some kind of domestic animal. They aren't. As



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far as they're concerned, a human being is food."

"But—what made them come out?"

"This is a warm day. They only hibernate during the cold weather. Any loud noise on a day like this will make them restless. There was a lot of loud noise down here."

"But . . . but . . . If you knew this, why didn't you *warn* us? To just *leave* us here, knowing that, was the same thing as turning them loose on us!"

Dave ignored the illogic in this, and noted her changing attitude. He said, letting his voice show hurt, "We *tried* to. And got shot at for our pains."

" 'We,' " she said. She looked alertly around.

Dave reminded himself that the girl *was* shrewd.

He said with a trace of sarcasm, "Were you under the impression that I'm all alone on this planet?"

"Why don't your friends show themselves?"

She half-raised the gun, and looked around searchingly.

The blond girl said nervously, "Chloe—"

Dave said shortly, "You fired at *him* yesterday." Cautiously, Dave stood up. If Fielding thought life with this girl would be pleasant, *he* could try it. But, at any rate she wasn't aiming the gun at him. Again she looked at him alertly, then glanced at the sky. He decided to waste no time putting the next part of his plan in action, and swayed slightly on his feet.

The blond girl gave a little cry, and started toward him.

"Keep back," he warned. "Don't . . . don't come near me. I've been sick." He took a wavering step, then fell in the snow.

An instant later, someone turned him on his back, and was cradling him gently, as another voice shouted—and this was a masculine voice, tense and authoritative.

"Leave *him* alone. We won't shoot him. Get everyone out of that ship!"

Dave let himself fall back, then someone planted a kiss on his forehead.

There, *that* was more like it. But this wasn't over yet. He kept his face blank, and lay slackly motionless. He could hear the tall girl explaining what had happened to someone, and then there were a series of short sharp authoritative questions. When she explained how Dave had come down the bluff, whoever was doing the questioning dismissed the possibility brusquely. The girl angrily restated it. Again, whoever was doing the questioning brushed the idea aside. Sarcastically, the girl pointed out each individual bent branch, twisted bush, and mark in the snow at the bluff top that Dave had pointed out. There was a silence at the end, then Dave could hear the sound of feminine voices, from the direction of the yacht.



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Dave opened his eyes. Someone said sharply, "He's awake, Captain!"

Dave slowly sat up.

Poised in midair before him were two more dish-shaped grav-skimmers, these somewhat larger than the others, marked with a blue stripe around the rim, and bearing a yellow shield at intervals. In white letters on the blue were the words. SPACE POLICE. In the skimmers were heavily armed men in uniforms roughly similar to those of the Space Force, but with different insignia.

Dave could have done without this complication, but he had taken the possibility into account. Now he readied his defenses.

The second skimmer was already starting to lower itself as the girls looked up, some supporting others who were apparently faint from the grisly scene around them. To jar things into motion, Dave turned and started to walk unsteadily away.

"Halt!" came the shouted order. "Turn around! Where do you think *you're* going?"

Dave turned and held his hands at his mouth to make a megaphone.

"We've been sick! I didn't want you to get it."

"*Sick*?" The man with captain's insignia stared at him.

Dave glanced at the girls.

"I tried to warn them."

The captain glanced around. The blond girl was right in the middle of the others. The only one standing aside, looking at Dave with a very peculiar expression, was the tall girl with the gun.

The captain looked back.

"Sick with *what*?"

"Well, we've had the pox, but—"

"*Pox*" shouted the captain. He whirled. "Raise that—" He reached out and seized a power megaphone.

"LIFT THAT SKIMMER! LIFT SKIMMER, I SAY! *THIS PLANET HAS THE POX!*"

Dave shouted, "We're over it now! We've . . . We're over it!"

The captain made a signal, palm upward, sweeping his hand sharply up, and both skimmers rose fast. As if remembering something, he looked back down at Dave, and spoke through the megaphone, his voice already faint because of the speed with which the skimmers were rising.

"Take plenty of liquids—citrus fruit—avoid exposure—keep the patients warm—keep complete records. Good luck. Bury those rats there. Other visitors are permantly restricted to the planet. Ship salvage to the first claimer. Impound log and . . ."

His voice faded out, and Dave waved, slipped in the snow, let himself fall to one knee, then got up and looked up again, careful to keep his face free of any expression but a look of anxiousness. The skimmers were too small now to be seen except as dots, but it didn't



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follow that their scanners could not record his every motion and every line of his face. There, now they dwindled off to the south, and vanished entirely. He was over *that* hurdle. But there were still the possible recorders on the yacht itself.

He looked around to see the tall girl standing directly before him, studying him with a wondering look. He glanced around at the bluff and the forest, and then back at the girl.

"Those packbears may be back anytime. It might be a good idea to—"

From the top of the bluff came the warning crack of a rifle. Apparently the bears were already coming back.

"Get into that skimmer," he said, getting into the other—which had the workable gun. "Stay right behind me. You don't want to set down in the wrong place again. You take half of the girls, and I'll take the other half."

The tall girl glanced back at the forest, and motioned the girls into the skimmers. Dave briefly studied the simplified controls, experimented with them for a moment, then swung the skimmer swiftly up, the sheer face of the bluff dropping down and falling back fast as he streaked along the face toward the east. He glanced back, saw that the other skimmer was no longer following but was starting to swing away from the face of the bluff. He whipped his controls around, and shot for the trees between here and the more distant clearing. The second skimmer whirled to race him, as the girls looked urgently around, gaining altitude as forest and small clearings flashed past below, and then Dave began to gently lower the skimmer as a hole through the snow-laden trees appeared. The skimmer behind instantly followed his example. He glanced at the girls clinging to the handholds, then whipped his skimmer up and slashed through the treetops, sending a shower of snow flying out behind him.

Directly in front of him, another space yacht appeared, sitting upright on its base. From behind and below came shrieks, and a short burst of anger. Dave landed beside the space yacht, put his hand on its cold flank, and said, "By the interstellar laws of salvage, I claim this abandoned ship and its effects for my settlement, to be held in common, and disposed of in accord with the decision of the settlement's duly-appointed leader or his successor, or in whatever lawful way may be duly determined by the members of the settlement."

He glanced up, and saw the second skimmer, heaped with snow, settle slowly to the ground. He glanced at the still paralyzed girls in his own skimmer, stepped out, put his hand again on the yacht, and repeated what he had just said.



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The tall girl looked at him with smoldering eyes.

"You don't miss a bet, do you?"

"Ma'am," said Dave politely, "I've done my best to keep the bears from killing you. As far as I know, I haven't hurt you, or threatened you. But if you want to be angry with me, there is nothing I can do about it, I guess."

"Very neat." She smiled, bit her lip, and said, "All right, take us to your settlement's duly-appointed leader." She turned away. "Phyl, for the love of *Pete*, will you shovel some of this snow out, but—Watch it! Just the *snow*! Here, I'll hover. You'd better reach out and get that."

As she turned, Dave had the leisure to observe that the girl *was* attractive, as Fielding had said.

He looked all around, saw nothing that should pose any threat, considered the location of this second clearing, then looked around the interior of the skimmer. It was bloody, with several holes torn through it, but by pure luck nothing important seemed to have been hit. As he looked searchingly around, he noted a thing like a little cylinder—something like a hand-held microphone. He picked it up, examined it curiously, and noted a small nearly round lens at the end, with a button at the side. He remembered the girl who had set down the ax awkwardly, and felt in her pocket for something small, that she had then held against the ship, after which the door had opened out. He glanced at the side of this ship, and spotted what looked like a small lens, about the size of the end of a man's thumb.

He glanced at the tall girl, and said, "Could you come here a minute?"

She hesitated. "You'd better take me to whoever's in charge of your settlement."

He nodded. "Just come over here, and in theory you'll be talking to him."

She waded through the snow. "What do you mean, 'in theory'?"

"Things are pretty informal unless there's trouble."

She glanced thoughtfully at the girls.

"If you're the settlement's leader, you've *got* trouble."

"I was thinking the same thing. Now, I take it you're pretty familiar with this ship, so maybe you can—"

Her eyes glinted.

"*They* followed *us*," she said. "There were fifteen yachts on this excursion, but after what happened the last time, we broke up. We didn't want anything to do with them."

"After the heroes smoked battlewagons, and proved how tough they were?"

She nodded. "It was all right up to that point. It was a pleasure trip. We have been trying to get back to the same viewpoint, but I'm



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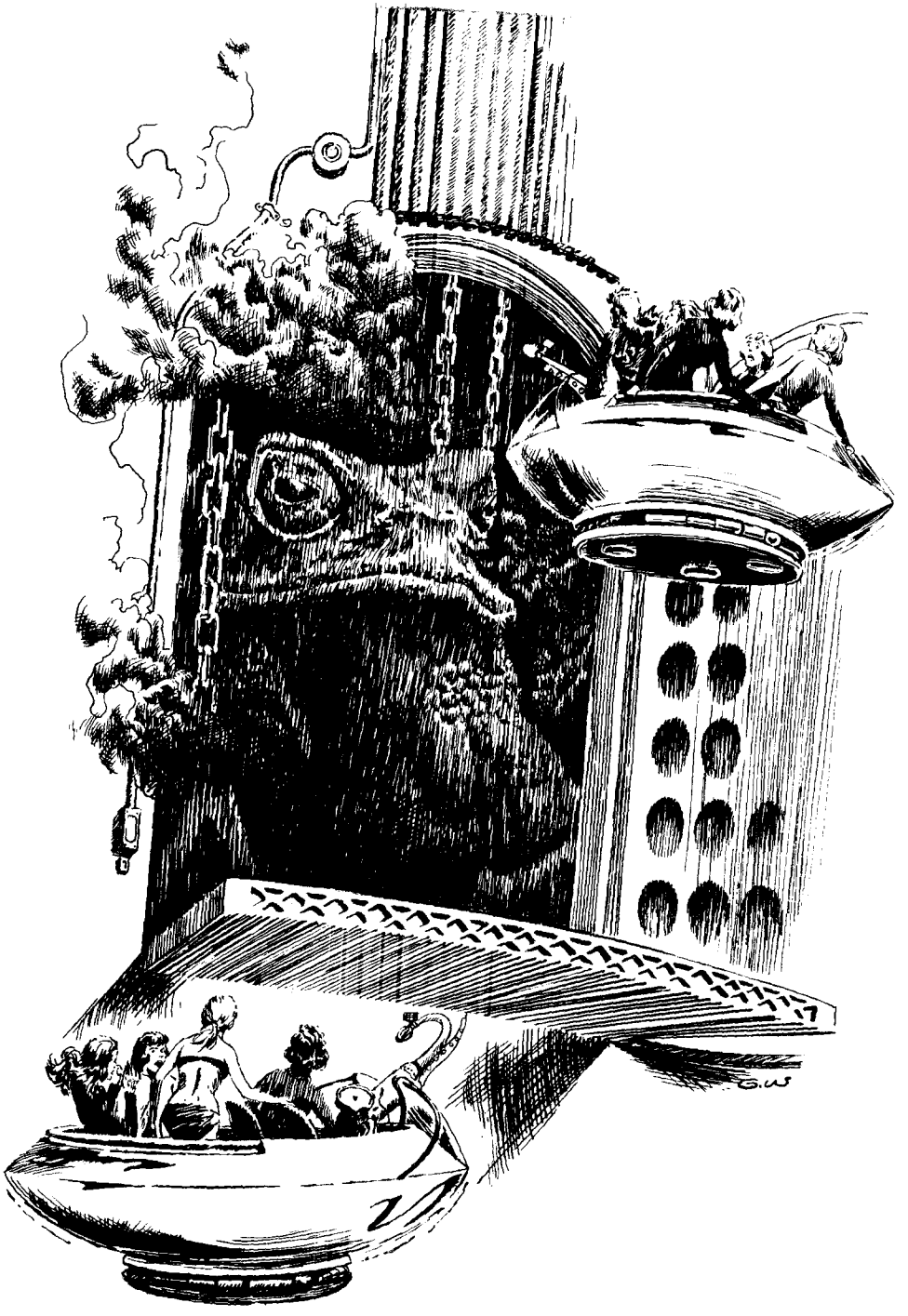

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afraid we would never have made it."

"You realize you're marooned here."

"You misrepresented what you'd had. I was watching you."

"*If* I misrepresented, you said nothing to correct me."

She reddened slightly, then said, "There's such a thing as watching a very cool operator, and wondering just what he has in mind. And then finding out too late."

"The point is, the Space Police have you down as exposed to pox. Try and leave here, and there's a good chance they'll pick you up on their screen and put you right back down."

"What do we lose by that?"

"Time and energy. And, it would be illegal for you to take this yacht."

She nodded. "Since you've claimed it. And, of course, it's all down in the automatic log. Well, what do you want to do? We *can't* take the other one. Your bears tore the aft section to pieces."

"Not ours. The bears are wild."

"The results are the same."

"That's what I'm trying to explain," he said. "You're marooned. Naturally, we'll try to help you—"

"Why can't you get in touch with these Space Police, using the communicator in this ship, and explain that we haven't been exposed to this pox, whatever it is."

"Because," he said seriously, "I'm not certain you haven't been."

"Is that what you just had?"

"No. I didn't say it *was* what we *just* had."

"But you knew that blockheaded captain would jump to conclusions."

"He may have been right. I hope not."

"No matter what I say or do, you keep right on going," she said exasperatedly, "And you're always one step ahead. All right, we're marooned here. Doesn't that create something of a problem for you?"

"I was about to suggest that we open up the settlement's new ship, here, so you can all go in and have shelter, at least. Then we can figure out what to do next."

"All right. Let's do it." She was watching him curiously.

Hunsacker cast a brief glance at the yacht, and nodded. He floated up in his skimmer, and she promptly followed in the other skimmer. He studied the key, held it against the lens-like depression in the side of the yacht, worked the small recessed button in the side of the key, and stepped back to give the girls a good view of whatever this nest might have to offer.

The door swung slowly back.

Around him, there was a gasp.

From the interior, there loomed through thick smoke a kind of huge brassy motionless toad with redly-glowing eyes. Chains with weird attachments dangled through the murk from some overhead hook. There was an overpowering stench of filth and incense.



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The skimmers swayed as their passengers sat down.

Dave glanced around at the tall girl, and now his gaze caught a trace of motion from the distant block the colonists called Iceberg Mountain. From here could be seen what seemed to be specks traveling across the distant snowfields, the specks enlarging and shrinking one after the other.

He said, "If you'd rather stay with us, instead of here, we'd be glad to have you."

There was murmur of eager agreement.

Dave shut the door of the yacht, studied the sky overhead, and turned to the girl, still watching him alertly from the other skimmer.

"Keep your eyes open. If you look around at that mountain, you can see what looks like specks. That's a flock of a kind of giant bird that winters in the south. They stick together when they're flying north, but they have scouts at a distance that watch for food. Any one of us would do."

She looked intently at the distant mountain, and nodded.

Dave said, "Stay right behind me, and be ready to go into the thickest part of the forest if you see one of them diving. And stay low. Don't go *above* any of those taller trees, back in the thick forest. There's a thing in some of them that will try to knock down anything that flies above it."

Dave took a careful look all around, then led the way low and fast across the open ground, dotted with clumps of small trees, that connected the two clearings.

As they emerged into the clearing below the bluff, where the smashed space yacht stood, there was a gruff warning bark.

Dave saw the bears, glanced up, and there, far overhead, was a speck, drifting in the blue sky.

"Hang on," he warned, and the bluff, with its tough shrubs clinging to cracks and crevices, dropped past as they climbed.

From below came a weird cough and whistle that the bears used as a signal. The purpose of this noise was a source of controversy amongst the colonists, but as the lip of the bluff dropped past, Dave lost no time getting the skimmer back into thick forest. He landed amongst the thick-boled trees with their dead lower limbs radiating like spokes, and looked around searchingly.

The second skimmer set down nearby, and he gestured to the tall girl to come closer yet.

"We'll have to switch the load around. If that thing comes in here, one of these skimmers has to be able to fight, and move fast. The only way to do that is for the two of us to be in one skimmer, and everyone else in the other."

She nodded, and a few moments later the change was made. A daz-



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zling line that sprang out as he squeezed the trigger demonstrated that the gun still worked.

A quick check near the edge of the bluff showed no sign of danger, and Dave recovered his gun, apparently left there in its wrapping by Fielding and Terrill in case he should need it. Their tracks led back down the trail toward the loose cluster of cabins that made up the settlement.

She watched alertly. "You were telling the truth. But there were *three* of you, not two."

He eased back into the forest.

"I didn't say there were only two of us."

"You tried to lead me to think it."

He glanced at her, noting again that she was pretty and well made, though dressed to conceal the fact. But while he noted this, he was conscious of something else, that had more impact in this part of the universe:

*She used her head.*

He tried to scan the sky, wondering where that speck had gone, but the trees blocked his view.

"All is fair," he said casually, "in love and war."

She started to speak, stopped, colored slightly, and looked exasperated.

"Do you ever stop thinking?"

From far downhill, the sound echoed through the forest.

*FLACK!*

There was a distant scream, an urgent shout. Belatedly, a shot rang out.

He eased the skimmer carefully through the trees.

She looked around. "What was that?"

"That's what happens here when you stop thinking."

"What—"

"The flit . . . the bird that was overhead." He glanced around. "The only time you dare stop thinking is inside the cabin with the window shuttered and the door barred, your gun cleaned, loaded, and ready at hand, and either a good fire or the chimney stone down to block the flue. There *are* places where not thinking is a way of life. It's a luxury here."

"What *happened*?"

"My friends were probably telling what had happened up here. The flit . . . the bird, that is . . . was dropping after us, saw it couldn't make it, saw the crowd, and changed its angle of descent. That 'flack' noise is what you hear when it opens its wings after a long plunge from practically out of sight overhead."

They were far back in the trees now, following the direction of the downhill trail, and the second skimmer swung carefully around a bristling tree trunk to follow them.

She looked all around, then said suddenly, "It must be that you need women in your settlement."

He smiled. "An accurate deduction. How did you know that?"



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"When I see someone use bears to eliminate pirates, germs to frighten Space Police, and the pirates' bad housekeeping to move the women into his settlement, it's natural to think he *needs* them there. Otherwise, we'd be far away by now."

"We do need you. But what you just saw was ninety percent luck."

She glanced alertly around, then looked at him with a smile.

"You can tell a real operator by the fact that what he does creates a bigger effect than anyone would expect. He sneezes, and a bridge falls down."

Dave sneezed, and looked around. The forest looked back blandly. He glanced at her.

"Nothing happened."

She nodded "A top-rank operator often *conceals* the fact."

"If you see it, it's not concealed."

She looked around at the forest. "The real proof is that you borrowed strength when you needed it. You smashed the pirates using the strength of the bears, and in effect you gave the Space Police orders by borrowing the authority of their blockheaded captain. And you didn't *tell* us to come here, and so make us resentful; you put us in a place where we were *glad* to come, due to the force of our own reactions."

"Ninety percent luck."

"It's the other ten percent that makes the difference. It takes a score of ninety-nine to get some things done."

He noted a slender sapling that climbed between two larger neighboring trees. The interlocked branches of the larger trees sagged under the weight of snow.

Carefully, he eased the skimmer into the confined space between the outthrust dead lower branches of the largest tree, and the sapling.

"As for borrowing strength," he said, "tell me some other way to get anything done. When a man fells a tree, does *he* drag that huge mass of wood, bark, and foliage to the earth? No. *Gravity* does the work. When he wants people to cooperate, can *he* compel them to be cooperative? Of course not. He appeals to some interest that will move them. The *interest* does the work. If he flies a spaceship, is it *his* muscle that moves the ship? Why, no, he had to find a way to get some atoms to cooperate, and it's *their* power that moves the ship. The strength that helps him, as you say, is borrowed strength. But what else can he use? He *has* to borrow strength. The fun starts when he forgets, and imagines it's his."

She thought a moment.

"But at least, you don't deny that you *are* an operator?"

He bumped the sapling lightly. A clump of snow plummeted down to the side, distracting her attention.

"Not me," he smiled, and brought the new colonist to the settlement. ■



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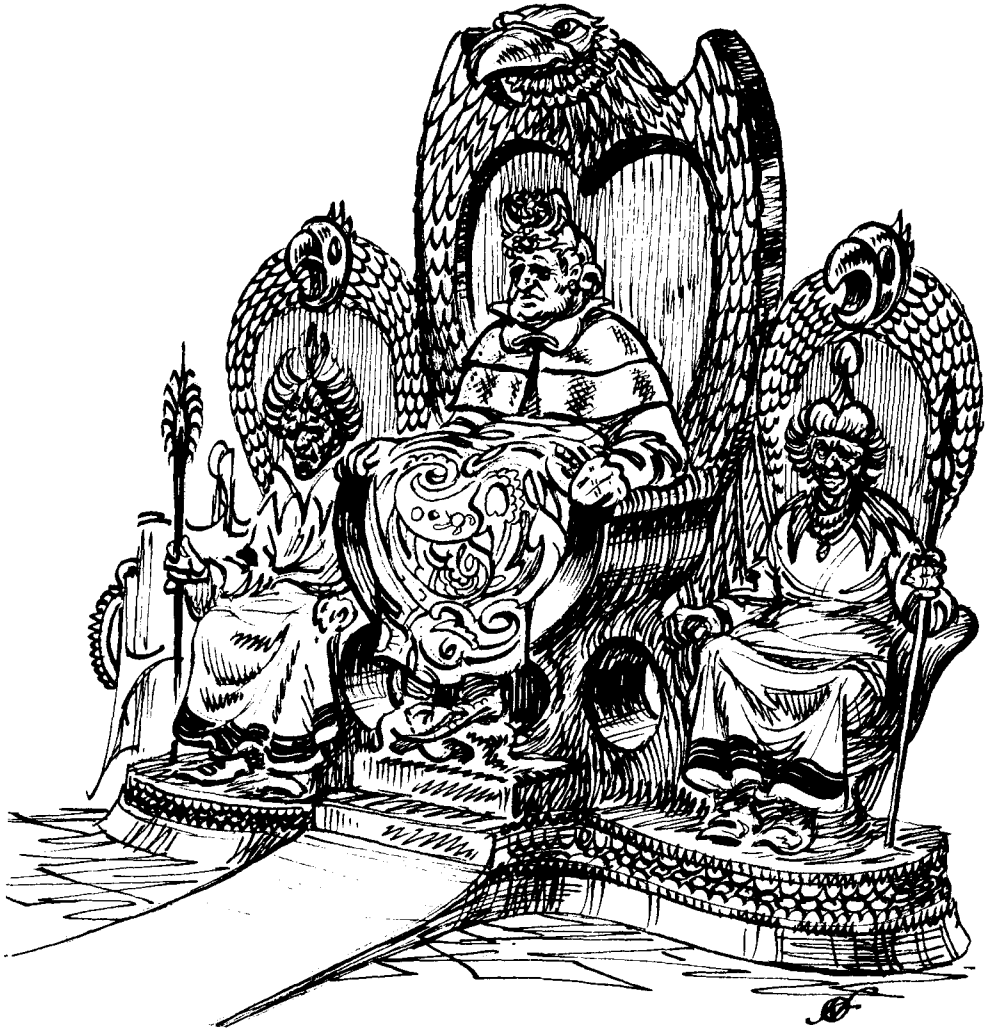

# THE WORLD MENDERS

*Second of Three Parts. The problem of the* olz *might be dominant—but there were plenty of others in understanding Branoff IV. And part of the trouble was they'd never done a real cultural analysis of the people!*

LLOYD BIGGLE, Jr.

*Illustrated by Kelly Freas*

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## SYNOPSIS

*The Interplanetary Relations Bureau had as its most important function the qualification of nonmembers for membership in the Federation of Independent Worlds. Applying its motto: DEMOCRACY IMPOSED FROM WITHOUT IS THE SEVEREST FORM OF TYRANNY,* with fanatical *diligence, the Bureau attempted to improve the nonmembers' technology and to reduce their political establishments to the minimal level democracies required for Federation membership. The most critical obstacle was that this had to be achieved by the native peoples themselves without apparent outside intervention. The Bureau functioned on nonmember worlds without those worlds being aware of its presence.*

*Some problem worlds tenaciously defied the Bureau's efforts. When one such world was brilliantly brought into line by an officer of the Cultural Survey, the Bureau immediately requested CS men for service at all levels of Bureau organization. Because there weren't enough available, the advanced trainees of the Cultural Survey Academy were, to their consternation, transferred to the Interplanetary Relations Bureau.*

*One of them was AT/1 Cedd Farrari, who was assigned to an IPR classification team on Branoff IV—a world whose only civilized political entity was the land of Scorvif, with a master race, the* rascz, *a race of slaves, the* olz, *and the whole controlled by a god-emperor or* kru, *with a small class of intermarrying nobility, a potent priesthood, and a powerful military hierarchy with an excellent army. The Bureau confidently predicted that it would be two thousand years, at least, before the* olz *could take their first tentative step toward democracy.*

*Farrari understood little of the IPR mission, and at first he was delighted with the high level of culture he found on Branoff IV. He studied the arts and crafts, pondered the rudimentary literature, and listened to the music, and he quickly discovered close relationships between his work and that of other specialists. The Cultural Survey view of culture, as a common denominator in all areas of study, enabled him to make valued contributions to many projects. He also made friends and became casually acquainted with clairvoyant Liano Kurne, a strange young girl who had lost her sanity as a result of an accident that took the life of her husband.*

*Farrari enjoyed himself and kept furiously occupied, but as time passed uneventfully he became concerned that he was somehow failing to fulfill his assignment: the study of IPR problems from the Cultural Survey point of view. After a talk with the world coordinator, Ingar Paul, it occurred to him that in*



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*concentrating on culture he had overlooked the people for whom that culture was intended. From the records section he borrowed a box of teloid cubes—time images of the* olz. *The first projection made him the horrified spectator of the fatal beating of an* ol *woman by a* durrl, *or overseer. She had stolen a mouthful of food, and as punishment the* durrl *lashed at her with a* zrilm *branch, a shrub whose barbed leaves tore the flesh and also seared it with a caustic secretion. Other natives watched the beating with apparent indifference, but the expression in their eyes defied Farrari's comprehension. One such experience was enough, and he meekly returned the box of teloid cubes.*

*Then he learned by accident that Liano Kurne had suffered a similar beating.*

*When a new teloid cube arrived of a tapestry that had been hung over the facade of the* kru's *Life Temple, Farrari deduced from the scenes portrayed on it that the old* kru *was dead. This made him momentarily a hero, because it gave IPR a head start in its critically important study of the succession of power. Peter Jorrul, the field team commander, was so impressed that he took the Cultural Survey trainee to Scorv, the capitol city, to find out what else he could do.*

*Farrari reached Scorv disguised as a baker's apprentice, and he was immediately astonished to learn that the* rascz *were not monsters, but a decent, serious people with a high regard for work, family and an orderly society. He was also surprised to find that few* rascz *had ever seen an* ol; *the slaves were a monopoly of the* kru.

*All of the bakery personnel were IPR agents, and between Bureau assignments they had to produce a normal quota of baked goods. Farrari spent most of a night beating scum in huge vats that was used as a leavening agent in bread. So many agents had special assignments to study the coronation of the* kru's *successor that the bakery was shorthanded, so when orders were received a bake a ceremonial cake for the* kru *and present it at the palace. Farrari was hastily trained to take part. His function was to walk at the heels of the journeyman baker, Gayne Prolynn, carrying the cake: a bread-shaped pastry wrapped in a white cloth ornamented with the black crests of the* kru.

*Farrari had a brief but fascinating glimpse of the city of Scorv and its people, and he was able to see first hand the contrasting styles ponderous, ancient buildings interspersed with gracefully decadent of architecture he had studied: later structures. The most interesting of all was the ancient Tower-of-a-Thousand-Eyes, which rose above the* kru's *Life Temple and was the eternal resting place of the rulers of Scorvif—each interred be-*



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*hind the eye of his choice through which he could forever keep watch over his people.*

*Trumpets sounded abruptly, the populace erupted into the streets, and Gayne and Farrari were caught in the ceremonies of the coronation. They became separated, but Farrari felt completely safe in the enormous crowd. The ceremonies concluded when the portrait of the new* kru *was unveiled for his worshipful subjects.*

*Before the crowd could disperse, a group of priests came from the temple and began to push their way through it. There was no reason why they should pay special attention to a baker's apprentice, but they immediately surrounded Farrari and led him toward the temple—and to an inquisition in a language that he understood only slightly and did not dare try to speak.*

*He felt very much alone.*

## Part 2

### VIII

The broad sides of the Life Temple served as national annals and art gallery. The oldest reliefs, dating back more than a thousand years, were at ground level, and successive carvings followed row on row until the contemporary scenes were placed four-fifths of the way to the roof. Farrari knew every carving and had longed for an opportunity to see them in person. Now he passed them by with a fleeting glance and scarcely a thought. They entered the temple at the rear, with the mounted priest clomping up the ramp after them. Inside the vast portal he turned his *gril* over to an attendant and accompanied them on foot, and Farrari wryly meditated the fact that commoners were forbidden entrance to the Life Temple but a priest's *gril* was not.

Commoners were forbidden . . .

He asked himself, "Then what am I doing here?"

They had swept almost to the end of the long corridor when he thought to blame the cake for his plight. The priest had sighted the wrapping and crests, which explained how he was able to pick Farrari out of the crowd but not why he had wanted him. Commoners invariably presented their gifts at the *kru's* palace.

Several boys were gathered before the massive doors at the end of the corridor, avidly peeking into the room beyond. They were apprentice priests of various specialities; their robes differed, but all had the broad black stripe of the priesthood at the bottom. They leaped aside, two adult priests hauled on the doors, and Farrari and his escort passed through into an enormous hall.

The black base of the Tower-of-a-Thousand-Eyes protruded at one end of the room. Around it was a



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high marble dais upon which the *kru* was seated on an ornate triple throne with a high priest at a lower level on either side of him. In a niche above the throne, standing upright in an elaborately engraved, gold coffin, was the body of the old *kru*, already elevated above his successor on the first stage of his journey to his crypt somewhere in the upper reaches of the tower.

The massed nobility and much of the priesthood of Scorvif filled the hall. The coronation ceremonies were already completed; the *kru* wore the hand-painted robe and the short golden cape of divine office. He was middle-aged and flabby, with eyes deeply sunken above sagging jowls, and he did not seem an auspicious ruler for a worn-out civilization. Farrari studied him as long as he dared before he respectfully lowered his eyes.

He had already sensed that all other eyes in that vast assemblage were on him, or soon would be. They marched forward, and before the dais his escort turned aside. He stood alone at the foot of the ramp stairs that led up to the high throne and wished that he knew something of *Rasczian* psychology. A young apprentice newly arrived from the south would certainly hesitate, so Farrari hesitated, turned uncertainly, and did not move until one of his escorts hurried back to whisper an unintelligible instruction. Then, eyes averted and carrying the *kru's* cake, he mounted the ramp.

There could be only one possible explanation: they wanted him to present the cake, and thanks to IPR thoroughness, he knew exactly how to do it. Gayne and Inez had rehearsed the presentation scene carefully so that Farrari would not misbehave while Gayne was presenting the cake. Now all he had to do was take the role Gayne had portrayed.

Eyes still averted, gift extended in front of him, he reached the dais, gauged his distance cautiously, edged forward two more steps, and then sank slowly to his knees. His muscles, still sore from Gayne's prolonged rehearsal, protested achingly, but with set teeth he maintained his slow descent, and when his knees touched he leaned forward, straining to keep his balance, and continued the slow, settling movement until at the precise moment that his forehead touched the marble dais he laid the gift at the *kru's* feet. From behind him a murmur arose—of appreciation, Farrari hoped, and he felt that he'd earned it. Reversing the movement was much harder, but he managed it smoothly, gained his feet, and slowly backed down the ramp—one did not turn his back on the *kru*.

"And now," he thought, "let's get out of here—fast!"

His escort stepped to his side but made no motion to leave. On the dais an attendant was removing the



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soggy wrapping from the *kru's* cake. Farrari risked an oblique glance as the cloth fell away: the *kru* leaned forward, staring both high priests leaped to their feet; from the audience came gasps and muted exclamations, followed by an upwelling of talk.

A high priest's outstretched hand imposed silence. He spoke with the *kru,* spoke with the other high priest, raised his arm in signal. From somewhere in the rear came the sounds of a flurry of movement that swept past Farrari and rushed up the ramp. A fluttering group of attendants, handed objects to the two high priests: a table with a polished wood top—Farrari, risking another oblique glance, thought it entirely too much like a chopping block—two superbly polished, mottled stones, large and obviously very heavy, and an ancient sword. The high priests placed the table near the throne, set the two stones upon it, and stood the gift cake upright between the stones.

Then, with one of them carrying the sword, they descended the ramp to Farrari. His panic was under control when they reached him. The doors were too far away and guarded, there was no way out, and he could only obey and keep himself alert for any opportunity.

They led him to the top of the ramp, and he imitated them when they sank into the ceremonial bow. The one with the sword laid it at the *kru's* feet. Then they rose, the priests gently coaching Farrari with gestures, and the *kru* handed the sword to Farrari, blade foremost.

He was much too astonished to accept it, but a priest spoke softly to him, and he took the sword and transferred the handle to his hand. It was a massive thing, with broad blade and a very simple handle, and Farrari, because of his work with Semar Kantz, fancied that he knew rather more of its lineage than did the priests.

He gripped the sword and waited. It crossed his mind that a simple lunge would change this planet's history, but only momentarily—there would be another *kru* as soon as a new relief could be carved, another titular owner of the *olz,* and things would proceed as before.

What *did* they expect him to do with the sword—slice the cake? Sword, table and stones were obviously very old, and the tabletop was immaculate. Nothing had ever been sliced there. The priest spoke again, and Farrari desperately focused on two vaguely familiar words. One meant hit or strike—or stab? If he stabbed the cake, he might knock it off the table, and he doubted that they'd be telling him to make a stabbing motion in the direction of the *kru.* Strike, then. He'd thought the other was the word for bread, but perhaps it also meant cake. Strike the cake?

He tested the sword's edge with his left thumb and mentally in-



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dulged in several non-*Rasczian* curses. It was a ceremonial sword; probably it hadn't been sharpened since it was cast and it had been dull to start with. Not even an expert like Gayne could have made a respectable cut with such a blade. No wonder the tabletop was unmarked!

They were asking him to split the cake lengthwise, or try. He *hoped* that was what they were asking, because he couldn't delay longer and that was what he was going to do. The priest spoke again and gently pushed him toward the table. All eyes in the vast hall were on the cake. The *kru* was staring at it fixedly, the priests were staring at it . . .

Farrari stared at it. Strike . . . cake. And with a dull sword. He raised the sword with both hands and brought it down on the cake with all of his strength.

The sword hit the tabletop with a loud *clunk*. Farrari stared aghast at it—it had passed through the cake almost without resistance and left a deep mark in the polished wood. He stepped back, leaving the sword on the table. "When they see that, they'll want to try it on my neck," he told himself.

For the long eternity of a moment, everyone continued to stare at the cake. Then one of the priests removed the sword and pushed a stone aside, and the other priest caught the two halves of the cake as they fell. From behind Farrari came an eruption of excited babbling voices. As he waited tensely with eyes lowered, a movement caught his attention. The *kru* had leaped to his feet and was gawking at the bisected cake.

The priests made no move to quiet the uproar. They conferred with each other, one of them spoke with the *kru*, and then they led Farrari down the ramp. With a word of command they turned Farrari over to priests of less exalted rank, who led him through a pressing throng of nobility that gaped rudely at Farrari and attempted to touch him as he passed. The doors swung open for them, and they left the hall, marched briskly along a branch corridor, climbed a ramp, and entered a long, narrow room.

"What d'ya know!" Farrari breathed. "The art school!"

Circular openings in the wall looked down onto the assembly Farrari had just left, and at each of them several artists, all clothed in a form of priestly dress, were sketching—some with chalk on smooth slabs of stone, some on polished wood, some on cloth.

Attendants brought in the table, the stones and the sword, and Farrari found himself posed with the sword upraised while the artists circled him and studied his features. Either he was about to become immortalized on a new tapestry or relief for the temple, or what passed



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for a constabulary in Scorv wanted his portrait for its files. He could not decide which he would resent most.

Finally a very young priest came for Farrari and led him back to the lower floor. Another young priest greeted him with a smile, opened a door for him, placed folded garments in his hands, and withdrew with another smile and a half-bow.

The door closed. Farrari tossed the garments aside and hurried to the wide window slit. There were a few passersby in the square and several ranks of foot and cavalry soldiers positioned near the temple. The drop to the ground would be an easy one, but he had the uncomfortable feeling that to be seen climbing out of a window of the Life Temple must excite comment if not action—and the soldiers looked disconcertingly ready for action. He turned away reluctantly and examined the room.

It was furnished with a rough table with a bench, and a pallet on a stone slab. An empty niche in the wall probably had contained the old *kru's* portrait and would contain that of the new *kru* when the artists caught up with the demand. On the table was an oil lamp complete with floating wick. The room would be bitter cold in winter—it had an unusually large window slit and no source of heat.

Obviously it was a priest's living quarters, and whether or not the priesthood believed in their dogma, they were not luxuriating in it. "I suppose it's the honor of the thing," Farrari mused.

Then he examined the garments and found to his consternation that at some point during the day's ceremonies he'd joined the priesthood himself. The robes were different from any he'd seen, but they contained the black borders that appeared on every priest's costume.

He dropped them onto the pallet and returned to the window slit, and a short time later he had the good fortune to see, from an unfavorable angle, the exit of the *kru* and the nobility. He also noted that the soldiers accompanied the *kru*, which interested him much more.

The day waned, dusk came, and finally darkness. Farrari waited tensely, alert for the sound of his door opening, and the moment it seemed dark enough he went out of the window. He moved quickly to the side of the square and then edged along the square's high stone wall to the exit; but the exit was not guarded. The buildings were already shuttered, and the streets were deserted. He forced himself to walk with measured pace, retracing their route of the morning, and he did not feel secure until he had made his way down the encircling road from the hilltop. He approached the bakery from the rear, opened the door, and entered.

All of them were there: Borgley and his wife, Gayne and his wife,



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the apprentices, two men Farrari had not met. They were working furiously. Farrari looked at the baskets already filled and realized with a twitch of conscience that they'd started early so they could have the night to do something about rescuing him.

All of them stared, except Borgley. He glanced at Farrari, turned to an apprentice, and snapped, "Get a cloak for him. Take him to the rendezvous point. Fast."

The apprentice darted away. Borgley said to Farrari, "How'd you get away?"

"Through a window," Farrari said.

"You weren't guarded?"

Farrari shook his head.

"Why'd they grab you?"

"Because of the cake. It's a long story and I don't understand it myself, but—"

"All right. Tell it at headquarters. The important thing right now is to get you away from Scorv."

The apprentice returned with two cloaks, drapped one about Farrari, and donned the other himself. Borgley said, "Get going. I'll have a platform sent if one is available. Otherwise I'll send Haral after you with *grilz*, and you'll have to take him to the mill."

They walked a short distance along the crumbling road, struck off across a sandy waste, and abruptly skidded down the side of a shallow depression. After what seemed an interminable wait a platform settled beside them with Jorrul himself at the controls. Farrari clambered aboard, whispered his thanks to the apprentice, and they took off. Jorrul said nothing at all until they reached the underground room at the mill. Coordinator Paul was there, and several of the base specialists, but Jorrul gave Farrari no time for amenities.

"Tell us what happened," he said. "Everything."

They listened, they questioned him, they sent off urgent messages to base and to various agents, and through it all Peter Jorrul sat silently, a deepening anger twisting his face.

Finally he thumped the table and said bitterly, "A once-in-a-millennium opportunity. Wasted—like that." He thumped the table again.

Coordinator Paul remarked mildly, "I'd say, rather, that Farrari came through a sticky situation in very good shape. He was lucky, but he helped himself considerably. Many of our own trainees would have been scared witless. Farrari—do CS trainees by chance study dramatics?"

Farrari grinned. "Not by chance. By deliberate, malicious intent! The only way to understand the art of the drama is by acting, or seeing it acted. I took part in at least one performance a week for four years."

"That must be the explanation; 178—that's our *krolc* who got into



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the temple for the ceremonies—says your performance was magnificent, and he hadn't the slightest notion you were IPR until the flap about your disappearance shook the Life Temple to its ample foundations. In retrospect he thinks you were a little too good. A bungling baker's apprentice should have been nervous."

"I was nervous!" Farrari protested.

"It didn't show. No one thought about it at the time, including 178, but every priest in Scorv is thinking about it now. That, and the fact that you never spoke to anyone."

"I didn't dare try," Farrari said. "Anyway, I didn't have to. They repeated everything they said to me, and eventually I could make out a word or two and guess the rest. But I still don't understand that silly ceremony with the cake and why they suddenly decided to make a priest of me."

"The *kru's* priest," Jorrul said, his bitterness still intense. "Think of the potentialities! And it had to happen to Farrari. Any other agent—"

"No." The coordinator shook his head firmly. "It wouldn't have happened to any other agent, and it shouldn't have happened to him." He turned to Farrari. "Even in such a marvelously efficient organization as IPR there are occasional goofs. Or had you noticed?" Farrari thought it best not to answer.

"Borgley took you to Scorv," the coordinator went on, "and about the time you arrived there Borgley was called back. He told his assistant to look after you, but, in his rush to put things in order so he could leave, he neglected to tell him why you needed looking after. All Gayne Prolynn knew about you was that you were some kind of superexpert on Scorvif: you knew the *kru* was dead before anyone else did, you knew the relief had been removed from the Life Temple, and when you asked to speak with the coordinator everyone jumped. He naturally assumed that you could handle a simple role like that of the baker's apprentice with a little coaching, and by taking you with him he was able to leave an experienced person at the bakery. He hadn't an inkling that you'd had no IPR training and weren't even fluent in *Rasczian*."

"It was *still* a wasted opportunity," Jorrul growled.

"One of the critical things you didn't know," the coordinator went on, "is that an IPR agent never allows himself to be trapped in a crowd. That's why you lost Gayne. As soon as he saw what was happening he worked his way sideways and managed to stay near the entrance to the square—where he could be one of the first to leave. By the time he noticed that you weren't following him, you'd disappeared." He turned to Jorrul. "There's no point in speculating



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what might have happened with someone else. A trained agent would have been on his way home before the priests moved into the crowd. A trained agent would have quietly removed the gift wrapping when the crowd's attention was on the priest. No, this opportunity could only come to someone who wasn't prepared to accept it. I think Farrari did well."

Farrari said dryly, "I'd still like to know what it was that I did."

"We had fourteen people in the crowd, not counting you," the coordinator said. "We had one inside the temple, and we shot long-distance teloids from three different locations. When the teloids are processed and all of the reports coordinated there won't be much that we won't know about the succession of a *kru*, but we already know a lot more than we did this morning. One of the things we know is that as soon as the *kru* and the nobility enter the temple for the coronation ceremonies, delegations of priests are sent into the streets to do two things: to find a commoner to present a gift to the new *kru*, a very important ceremony that probably dates from some remote time when the commoners had a role in the selection of the *kru* and affirmed their choice with a gift; and also to bring loaves of fresh bread from the city's bakers. The first person to appear with a gift was to be taken directly to the temple, the only time, apparently, when a commoner is admitted there. Others were to be taken to the palace to present their gifts in the usual manner at a special audience. And you, Farrari, you dislocated their program. The delegations went forth to cry, 'Gifts for the *kru*,' through all the streets of Scorv, and one of them found a commoner with a gift waiting almost at the temple door. Since he couldn't possibly have known about the ceremony in advance, it was considered an extremely auspicious sign."

"Not by me," Farrari growled.

"But it was. So they rushed you to the *kru*, and the gift turned out to be—bread!"

"Cake," Farrari protested.

"Bread," the coordinator said firmly. "Not even Borgley knows why that cake is baked the same shape and size as bread, but that's the tradition. One of the *kru's* ancestors was fond of it, the bakery reserved the recipe for him, and it became known as the *kru's* cake—but probably no *kru* since then has ever tasted it. Because of its appearance it would be mistaken for bread, and few food gifts to the *kru* are actually eaten. The *kru* couldn't eat all of them, and it'd be sacrilege if anyone else did. Anyway, the cake looked like bread, the priests and everyone else were thinking of the bread the delegations were to bring, and they immediately concluded that the cake



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was bread. And because it was an especially fine-grained cake, it virtually fell apart when you hit it with the sword."

"At which moment they should have known it wasn't bread," Farrari observed.

"What does it matter what it was after the ceremony? If the Holy Ancestors by some miracle changed the bread to something else to bring about the prophecy they desired, that was no more than to be expected on a day of miracles. First, a citizen was waiting with a gift. Second, the gift was bread. Listen. A group of carefully-selected young priests had been practicing, since the day of the *kru's* death, to develop skill at cutting a loaf of bread with a sword. According to tradition, each would have an opportunity, and the one who produced the longest, cleanest cut would be made the *kru's* priest—a special position and potentially one with great power and influence."

Jorrul muttered something.

"So the first gift was bread. Through some obscure tradition or maybe a whim—remember, it's our first succession—it was decided that the humble young donor should have the honor of wielding the sword of prediction first, on his own bread. That was done. Only it wasn't bread and you cut the thing completely in two, which is impossible. Not even a skilled baker could bisect a loaf endwise with a sharp knife." He paused and then said resentfully, "You still don't understand what you did? Listen, you young idiot—by slicing that loaf neatly from top to bottom you guaranteed the new *kru* a reign of unending glorious achievement—and eternal life! No wonder they canceled the performance by the other candidates and immediately made you *kru's* priest! Who could have improved upon that?"

"I could have botched it," Farrari said regretfully. "But I sort of had to guess what they wanted, and since I hadn't any previous experience I was just as surprised as they were."

"Never mind. The final miracle was your disappearance, which set them thinking, and one of the things they thought was that all the time you were there you didn't utter a sound. Now they've concluded that you yourself were the divine omen. They may trace you to Borgley, in which case he'll have a lovely story ready, but I think they'll be well satisfied with what they have and therefore won't want to look too deeply into this miracle. Of course you had to escape—you couldn't possibly have survived as the *kru's* priest. A mysterious omen who promptly disappears can remain mute, but an ordinary mortal priest, even if the *kru's*, has to master large quantities of dogma and incantations. You did well. But come with me I want to show you something."



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He led him to the roof of the mill and raised a tarpaulin. His handlight traced out the synthetic bas-relief that Isa Graan had made. The *olz*, twice as large as life-size, peered forlornly out of the slab of plastic. Five men, leaning on the sticks with which they scratched the soil, conveyed an impression of apprehension, as though momentarily expecting a *durri's* whip to terminate their stolen leisure. Three crouching women were sorting tubers; a fourth stood at one side, her arms outstretched to an *ol* child who seemed dubious that this uncouth creature was his mother.

"Magnificent!" Farrari exclaimed.

"Isa liked it," the coordinator said. "So much so that he made a smaller one for his office, and now everyone at base is culling favorite teloids to pick out something that would make a good relief casting."

"We couldn't have used it anyway," Farrari said. "You knew that?"

"Yes. We'd have to make the substitution before the ceremony begins, rather than at the proper place, and that *would* be tampering with a religious ceremony. It's an ingenious idea, though. I marked my statement of intent for maximum circulation, and there may be other worlds where it can be used immediately. It's in good hands; it won't be wasted."

They returned to the basement room. Rani Holt intercepted Farrari and asked, "What did you do with the robes they gave you?"

"Left them there," Farrari said. "I thought I'd be much less conspicuous going out the window in this clothing, and if I'd walked through the streets as a priest someone might have asked me for a blessing, or something."

"Too bad you didn't bring them," she said. "It's difficult to duplicate a garment when you don't have a model, and someday we might want to dress an agent as the *kru's* priest."

"The next time they make me a priest, I'll bring the robes," Farrari promised.

The following night they returned to base in a special high-speed passenger platform, and the coordinator found a message waiting for him: he was flatly forbidden to substitute a synthetic relief for one intended for a religious ceremony.

Accompanying the order was a new regulation that forbade tampering with *technography*.

## IX

Farrari did not fully comprehend his blunder until after he returned to base. An IPR agent as the *kru's* priest! Such a glittering opportunity should have clipped a few centuries from that two-thousand-year prognostication, and it had slipped away only because Cultural Survey AT/1 Cedd Farrari



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had not bothered to learn the *Rasczian* language.

He immediately commenced the complete *Rasczian* series and so immersed himself in the language that when he encountered Ganoff Strunk in the corridor one day the records chief stared at him and exclaimed, "I thought you were still in Scorv!"

Farrari said absently, "No . . ."

"I have copies for you of the teloids of the interior of the Life Temple. If I'd known you were here, I'd have sent them over."

"I've already seen the place," Farrari said.

"You've seen—" Strunk grinned. "I forgot. Of course—you were inside, you saw it first hand."

"I saw it," Farrari said slowly, "but I didn't look at it. Strange, isn't it? From the moment I first saw a teloid of the exterior of that temple I've wondered what it was like inside. Then when I unexpectedly found myself inside I never thought to look around."

"I don't blame you," Strunk said. "If the priests suddenly hauled me in there with me not knowing what they were up to, I wouldn't have had much interest in studying art. But it doesn't matter—our *krolc* got some excellent shots, including a couple of your performance. Everyone has been admiring your bow. Stop by and pick them up."

"I will," Farrari promised.

But he did not feel like working. Impatiently he paced the cluttered confines of his workroom, disregarding tasks left untouched since his Scorv adventure, and when he tired of that he went to one of the remote conference rooms and sat looking out at the dazzling sweep of mountain scenery. Liano Kurne found him there. Strunk had sent her to deliver the Life Temple teloids that Farrari had failed to call for; probably he had said, "Give these to Farrari," and anyone else would have left them in his workroom. She searched the entire base for him so she could place them in his hand.

Farrari thanked her and said he'd look at them when he found time.

"They're very interesting," she said.

"I'm sure they are," Farrari murmured politely. "It's a very interesting place."

He turned again to gaze glumly at the mountain scenery. He had unaccountably lost all interest in Branoff IV culture, and it was just occurring to him that for the first time since his arrival he was facing up to the job he was supposed to do.

He had been functioning routinely as a Cultural Survey officer, which was not his assignment. His assignment was to study IPR problems from the Cultural Survey point-of-view. He still didn't understand what that meant, but he



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hoped that an awareness of what he was *not* supposed to do was a step in the right direction.

When finally he turned away he was startled to find Liano waiting, her dark eyes fixed on him expectantly. She held out a small drinking goblet, a lovely thing of gold with an engraved figure on one side, a warrior in his most terrible aspect mounted upon a leaping *gril,* a bundle of short spears held aloft with one hand while the other poised a spear for throwing.

"That's marvelous!" Farrari exclaimed.

"Is it good—*art?*" she asked anxiously.

"It's splendid art. Where did you get it?"

"An *ol* gave it to me—to my husband and me. I often wondered where he got it."

Farrari fingered the goblet in abashed silence.

"We never thought about art," she went on meditatively. "I suppose that was because we worked with the *olz.* This is the only thing I ever saw that was art."

Farrari leaped to his feet and gripped her arm. "That's it!"

She gazed at him in wonderment.

He released her and continued excitedly, "I'm supposed to be studying IPR problems from the CS point-of-view. The *olz* are the main IPR problem on this planet, and the *olz* don't have any culture! Not in the limited sense of that word, certainly. No art, no music, no literature—no wonder I've been beating my head trying to figure out just what I should study. Now I see the answer: nothing. There can't be a Cultural Survey point-of-view without culture."

"Couldn't you give the *olz* some culture?" Liano asked timidly.

"You can't give people culture any more than you can 'give' them democracy. The *olz* wouldn't be able to accept it if it were offered. They're surrounded by culture, by a quite high level of culture, and they seem completely unaware of it."

He walked with her as far as the records section, where Ganoff Strunk greeted Farrari with a grin and then thoughtfully watched Liano as she returned to her desk. "They tell me you've been bit by the language bug," he said to Farrari. "Giving up culture?"

"Not entirely," Farrari said. "Just a moment ago I thought up a new principle for your Field Manual 1048-K: ONLY AN EXCEPTIONALLY TALENTED PEOPLE CAN CULTIVATE A SENSE OF BEAUTY ON EMPTY STOMACHS."

Strunk laughed merrily. "That's good. That's very good. Why don't you submit it? Did you know that IPR pays a hefty bonus for each suggestion that gets into the manual? The next edition will certainly have a Cultural Survey section, and



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there'll be a rare opportunity for someone to acquire wealth. The first edition of a new section includes all the truisms that any idiot could think up. After that it gets progressively more difficult to crack the thing."

Farrari set his teeth and refrained from telling him what the IPR Bureau could do with its slogan bonuses. "That classification formula you mentioned. High-low and low-high and the rest of it. Political factors over technological factors—wasn't that the way it went?"

Strunk nodded.

"I wonder if anyone in IPR is aware that the same result could be achieved with a formula that reflects the diffusion of culture through a society. On Branoff IV the lowest class, represented by the *olz*, doesn't have any. The upper classes have it all. That's certainly an unbalanced fraction."

"Hm-m-m—yes." Strunk's bald head bobbed agreement; his eyes fixed on Farrari alertly. "That's an interesting thought. As our political-technological formula improves, your cultural formula should also improve. Cause and effect."

"Which is the cause and which is the effect?" Farrari demanded.

Strunk's eyes widened. "Are you suggesting that an improvement in cultural dispersion would bring about a corresponding improvement in the political situation?"

"I don't know, but why not? It's easy to think up principles but infernally difficult to apply them."

"Interplanetary Relations has been aware of that for some time," Strunk said dryly.

"My hunch is that in every instance where your political-technological formula moves in the direction of improvement, there will be an accompanying improvement in the diffusion of culture."

"That won't get you much of an argument," Strunk said. "THE DEMOCRATIZATION OF SOCIETY BRINGS ABOUT A CORRESPONDING DEMOCRATIZATION OF CULTURE. Of course. Another obvious truism. It's like saying that daylight accompanies a sunrise. Why don't you submit that one, too?" He guffawed heartily.

"Since we don't *know* which is cause and which is effect, why not—THE DEMOCRATIZATION OF CULTURE BRINGS ABOUT A CORRESPONDING DEMOCRATIZATION OF SOCIETY."

Strunk stopped laughing. "*That* smacks of heresy. Let's see if there's anything in the manual."

He brought out his personal copy and began investigating likely references. Farrari went for his manual, and Liano scurried away to find hers, and the three of them sat around a table fretfully flipping pages and blearily skimming the fine print. Semar Kantz, the military expert, happened by, and when the problem was explained to



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him he ventured the opinion that an equally sound theory could be based upon the democratization of military training. The three men were arguing noisily, with Liano listening in timid fascination, when Coordinator Paul strode into the room.

"I've had four complaints about the noise," he announced. "What *is* going on here?"

"Farrari has this new theory," Strunk said meekly. "We were checking to see if there's anything in the manual, and then Kantz tossed *his* theory at us, and I suppose—"

"If you suppose theories that controversial should be discussed in a conference room, you're right." Paul pulled up a chair. "What is this new theory?"

Strunk explained, and the coordinator observed, "Cause and effect are tricky concepts. Your pair look to be trickier than most, but don't let that discourage you. If you want to do a preliminary study, I'll approve it. I'll even recommend it."

"That's just what I want to do," Farrari said. "How do I go about becoming an agent?"

The coordinator winced. "*Agent?* You'd have to undergo a strenuous program of training and indoctrination and testing before you could be considered, and you'd have to be tested thoroughly to find out whether you're even qualified to enter the program. For both of these steps you'd need your coordinator's approval, which you wouldn't get, and if through some oversight you got past those steps, you'd need Peter Jorrul's permission before you could enter the field, and that's even harder to come by. No, Farrari, I won't even discuss this with you. IPR personnel who come to us as potential agents have already taken those two steps, which eliminate nine candidates out of ten, and even so fewer than half of them qualify as agents. Your chances would be perhaps one in a hundred, and that wouldn't justify the trouble of training you. Besides, you're much too valuable to us in your own field. I'd be a fool to trade a good staff member for an agent of unknown quality."

"I see."

"Apart from that, making you an agent just to enable you to carry out this particular study would be a senseless risk and a stupid waste of time, because there's nothing you could accomplish as an agent that you couldn't accomplish better here at base. You can have every scrap of information you'll need that trained and experienced agents can possibly ferret out for you. Any plan you have that's at all reasonable will be put into effect by the same agents. What sort of thing did you have in mind?"

"Art is expression," Farrari said slowly. "Art is communication. Art is—but what do the *olz* have to express or communicate? I'd like to



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find out. At present the only link between the *olz* and their masters seems to be the *zrilm* whip, which is a rather one-way form of communication."

"That may be truer than you realize. Did you know that there is no similarity whatsoever between their languages? That is, if you can call what remains of the *ol* speech a language, it seems to be atrophying out of existence. We think the *olz* were the original inhabitants of these valleys, and that the first strong nomadic tribe to find its way through the mountain passes enslaved them. Except for the farm and forest overseers and the mine supervisors, who are a special bilingual class, no one communicates with an *ol* or has any reason to. If any *ol* has ever learned as much as one word of *Rasczian*, it's never come to our attention. This is a problem that could be close to the basis of all our problems, and we haven't begun to cope with it because we have no idea of how to begin. Would culture provide any kind of a solution?"

Farrari shook his head. "I can't see the *rascz* developing any interest in *ol* culture, and the culture of the *rascz* must be unthinkably remote to the *olz*. No, what I was wondering about was the extent to which the *olz* communicate with each other. Even the most primitive peoples develop diverse forms of art, and not infrequently the art is not only good, but surprisingly unprimitive. If the *olz* were once the masters of this land, they should have achieved some kind of minimal culture. What happened to it?"

"It must have atrophied along with their language. They have nothing very complicated to say to each other, and always the same people to say it to, and I suppose it'd be surprising if their means of communication, art or language, didn't deterioriate. Linguistically they have now reached a point where they can get along with a few grunts and gestures. These are extremely expressive and complicated grunts and gestures, mind you. They aren't the beginning of a language, but the end of one. The nuances are subtle and frightfully difficult to master. All of our agents have trouble learning *ol*."

"How long would it take for an idea to spread from one end of the country to another?"

"Years," the coordinator said bluntly. "There's little contact even between neighboring communities unless the inhabitants happen to work the same fields."

Farrari said thoughtfully, "Just for a beginning, this is what I'd like to know: Would the *olz* communicate if they had the means, the culture, or would they already have found the means if they had anything to communicate? I could best find that out by going among them and conducting experiments. For



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example, a very simple drawing—"

The coordinator was shaking his head emphatically. "We have twenty agents among the *olz*, risking their lives every moment of every day just by being *olz*. You can learn more from their reports in a week of study than you could with years of field work. A new agent among the *olz*, Farrari, has less than a fifty percent chance of survival."

"All right," Farrari said resignedly. "I'll study the reports."

The coordinator nodded and got to his feet.

"I could go with him," Liano said timidly.

The coordinator whirled to face her, tense with incredulity, and for an instant he lost his poise—but only for an instant. He asked quietly, "You mean—the same role you had before?"

She nodded. "There wouldn't be much for him to learn."

"No," the coordinator mused. "There wouldn't be. You'd take charge of his indoctrination?"

Liano nodded excitedly.

"All right. Pick an unused room and draw what you need from supply."

She hurried away, and it was Farrari's turn to gape incredulously.

"What do you know about her?" the coordinator asked.

"I know her husband was killed."

"That was only part of it. She was brutally mistreated. An *ol* lives in terror, Farrari, and too often that terror is justified. I hope you'll never have to find that out from personal experience. I could order you to undergo this training, but I'd rather you did it as a favor to me. I'll warn you—it may not be a pleasant experience. Liano hasn't been fully rational since the tragedy happened, and she's given to very strange moods and periods of partial, or even complete, catatonia. This is the first spark of interest she's shown in anyone or anything. She's a very special person, Farrari. I wonder if you have any idea how special."

"I know she's clairvoyant. When I first arrived—"

"I remember the incident. Will you help us? What I'm asking you to do is forget your theories, forget Cultural Survey, and work like the devil to acquire knowledge and skills that you'll never have the slightest use for. To help Liano. Will you do it?"

Farrari nodded.

The coordinator gripped his arm and smiled at him. "You're about to learn everything IPR has discovered about a *kewl*, who is the servant—slave, really—of a *yilesc*. It'll be much more than you'll probably want to know. The knowledge won't do you any harm, and in some roundabout way it might even be useful to you. You'll have to do your damndest, and work as though your life depended



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on it, because anything less than that might do Liano more harm than good. She's had tragedy enough in her young life. Don't let her down."

"Do you mean that I can't go into the field even if I do a good job?"

"That's exactly what I mean. You aren't training for the field. You're helping a gifted girl regain her sanity. Your superior won't be Jorrul, or anyone connected with the field team. It'll be Dr. Garnt." He paused. "Liano is a very special person. I wonder how she happened to become interested in you." Farrari blushed, but the coordinator was soberly contemplating the far wall. "It might even be worth the risk if it would help Liano," he said. He turned to Farrari again.

"First we'll see how the indoctrination goes. And then—if Dr. Garnt feels that going into the field with you would help Liano—"

"And if Peter Jorrul approves," Farrari added.

"If the doctor says it would help Liano, Jorrul isn't going to stop you. He'll ask you to do it. And when Jorrul asks someone to do something, it's an order."

## X

It was the year of the half crop, the year of hunger.

And the spring of starvation.

The disklike hooves of the great *narmpf* made explosive smacks as they were wrenched from the sticky green clay. The slanting rain struck the ground with a mysterious, drumming sound. Farrari, floundering along beside the cart, head bent, naked shoulders hunched against the cutting wind, could not remember the last time he'd been warm.

Liano sat crosslegged in the bed of the cart, gazing hypnotically at fluttering fingers that wove the rain into soundless incantations. Her tattered, yellowing robes bore the faded red smudges of occult symbols and oily traces of the heavy, penetrating smoke of night fires. The rain had washed the smear of *quarm* ash from her face and plastered the looping mass of her hair tightly against her head. Each morning the chill, drenching rains performed this miracle of rebirth and transformed her into a girl-woman not remotely unlike the Liano Kurne whom Farrari had known at base; yet this Liano was more of a stranger to him than the distant, ash-smeared seeress to whom he slavishly ministered around the nightfires.

Her eyes were bright and searching, her color exquisite, her manner calm and confident. He could not



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resist sending a long, admiring glance in her direction, for she was lovely.

She met his eyes. Her fingers continued to flutter; her frowning lips formed an admonition.

Stay in character.

Obediently he turned his eyes to the ground and concentrated on shaking globs of sticky clay from his bare feet. Liano raised her voice in a tremulous, high-pitched chant.

Stay in character. Both of their lives depended on it.

Liano trained him. The coordinator looked in briefly from time to time; Peter Jorrul, who was seldom at base, came when he could and stayed much longer. Once he observed them for an entire day, but he seemed to have little interest in Farrari's progress. He watched Liano.

At first she faltered. Her moods were kaleidoscopic—from the stern taskmaster, the tireless per-



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fectionist, she underwent abrupt and bewildering metamorphoses, becoming in an instant the exuberant child pleased and enthused with everything he did, or the enigmatic seeress whose chilling smile made him cringe. She could lapse for hours into a starkly staring, comatose state in which her face became alarmingly pale, her muscles twitched spasmodically, and her dark eyes gazed fixedly, unblinkingly at the nothingness of some remote dimension or—and this was the most disturbing—at Farrari. He wondered if she were divining his future and not liking what she found there.

Days passed before he progressed beyond the first lesson. With body slouched, knees slightly bent, feet pointed outward, every step a slow, deliberative action, he circled the room attempting to emulate the walk of an *ol* and puzzling as to how he should react to her swiftly changing moods. One moment she would be coaching him patiently; then would come an abrupt silence, and when, with aching muscles, Farrari turned to her after a tenth or thirtieth circuit of the room to learn if he was finally doing it right he would find her staring mindlessly. He asked Dr. Garnt what could be done at such times, and the doctor answered wearily, "Nothing. Just pretend it doesn't happen—if you can."

The *ol* language confounded Farrari. At first he thought it one of Liano's childish pranks; this conglomeration of grunts, chirps, clicks, moans and hisses a language? He decided that the *olz* were the most primitive people he had ever heard of, with less power of communication than many intelligent animals.

As he learned, he became less certain. To the *olz*, a few sounds could mean a great deal, and the many pitches upon which those crude articulations could be uttered were fraught with significance. Pitch variation could, in bewildering fact, make of a single grunt a vast vocabulary. He sought out the base's philologist and discovered that worthy individual to be as mystified by the *ol* language as Farrari was. "If you stumble onto any answers," the philologist said cheerfully, "let me know."

For weeks Farrari was occupied in learning to move and talk like an *ol*, and when finally he achieved a measure of proficiency he found to his dismay that he also had to learn to live like one and, ultimately, to think like one—or at least to behave as though he thought like one. The scene of his training shifted to an isolated, inaccessible valley, and there he and Liano lived for days. Farrari learned to manage an ugly *narmpf*, and though he came to admire its enormous, powerful body, he could foster very little affection for the slobbering beast. Its tiny head surrounded a large, toothless mouth



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that was lined with a hornlike material. Incongruously, it ate only *zrilm* leaves, and Farrari's first attempt to gather the poisonous, barb-protected leaves left him with puffed and bleeding hands. They treked from one end of the valley to the other, Liano riding in the cart and Farrari slouching beside it, turning the *narmpf* as she directed and hunching forward each time she reprimanded him for walking upright.

At night, while Liano submerged herself in the incantations she was struggling to recall, Farrari built two *ol* huts for them, of woven branches plastered with clay, kindled an *ol* fire by jerking a length of hemp back and forth in a tightly-held sleeve of bark, shaped a crude pot of clay, and cooked an *ol* meal: a boiled tuber with a handful of grain that puffed enormously in the boiling water and then seemed to shrink disgustingly the instant it reached the stomach. He lost weight rapidly and was always hungry, but that was part of his training: he was far too healthy-looking to pass as an *ol*.

In the darkness, while Liano sat staring at the fire, her face heat-flushed beneath its smear of ash, her hands performing a mysterious ritual for an imaginary *ol* audience, her dark, constricted irises opening onto depths no medical science could plumb, Farrari crept away to the cart and made his daily report on a concealed transmitter.

Coordinator Paul came regularly and watched them from a distance. Several times Jan Prochnow joined them at their night fire, wistfully watching Liano. Once he tried to question her, and each successive query dropped into a pool of deepening silence and disappeared without a ripple. His embarrassment became acute and his withdrawal a controlled flight. Farrari quickly learned that Liano would sit gazing hypnotically into the fire as long as it burned, so when he thought the time had come for her to sleep he let the fire go out.

But she was improving. Her periods of staring silence were less frequent, she became more exacting, the pace of his training intensified. Peter Jorrul brought an *ol* agent, and the two accompanied them for a day and a night, the agent studying Farrari's every move and, before he left, taking Farrari aside for a briefing on the horrors he was likely to encounter in an *ol* village. To Farrari, the real horror was that nothing could be done about it. The agents were not even permitted to try.

"Your main problem," the agent said, "is that you aren't relaxed enough. The *olz* are always relaxed. Sometimes their bodies don't even tense when they're whipped. You're having trouble with the language, too—you don't always say what you mean—but that's minor. The *olz* don't always say what they mean, either. The reason *ol* is so



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difficult is because it's so simple. I'll ask Graan to send you a tube of *ol* language cubes."

Farrari said to Jorrul, "Do you think I might—"

And Jorrul smiled and said, "We'll see."

The two of them left, and Farrari and Liano started another circuit of the valley, Farrari concentrating on relaxation. The next day Graan sent the language cubes. Liano played them for him while they traveled, and Farrari relaxed and listened to such good effect that when the agent came again he had no comment. Jorrul did; he told Farrari to stop eating. "By *ol* standards," he said caustically, "you're fat, and there is no such thing as a fat *ol*."

Farrari obediently starved off more weight. A week later the coordinator returned them to base, where Farrari had the contour of his forehead and the shape of his nose altered by surgery and sufficient body hair implanted so that he would not look like an abnormally bare-skinned *ol*. Another week in the field, and Jorrul returned to spend an entire day watching Farrari. At the end of it he grudgingly conceded that Farrari might.

"But only for a day or two," he cautioned. "We'll put you down in an outlying district where there's no one around but *olz* and a few *durrlz* and see what happens. And we'll keep a sharp watch on you."

The day or two became ten, and then twenty, and it suddenly dawned upon Farrari that they were on their own.

The *olz* fascinated him.

Even in fine harvest weather they huddled closely about the nightfire as soon as it was lit, as though wistfully attempting to soak up heat against the terrible ordeal of winter. The men seldom spoke, and when they did it was with a single grunt, a click, a gesture—threadbare remnants of the fantastically complex language Farrari had studied at base. He had to remind himself that the elements of *ol* speech as known to IPR had been painstakingly compiled over many years and from thousands of contacts. The whole was infinitely greater than any of its parts, for no single *ol* seemed to know much of his language. The probable destination of a spark flung on high was the ultimate limit of his abstract speculation; who had brought the last log to the fire and who would bring the next were the only social problems that interested him. If the language had words for *injustice*, for *rights*, for *slavery*, for *revolution*, IPR had never encountered them.

With the new harvest at hand, the *olz* had a full daily ration of food. While the weather remained mild, they would be warm. The cold and hunger of winter loomed ahead of them, and the starvation



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of spring that in the year of the half crop would inexorably take half their lives, but they were, at this moment in time, a tranquil people. That they seemed totally incapable of contemplating the future could have been the basis for their survival.

Liano fascinated him more than the *olz*.

The Branoff IV social structure was so commonplace that the more cynical IPR specialists referred to it as "trite." It contained only two incongruities, two elements of uniqueness. One was the fact that only the *kru* owned slaves. The other was the *yilesc*.

In the world's rigidly stratified society, the *yilesc*, her *kewl*, and her apprentice—if she had one—were the only individuals who existed outside the established order. Oddly enough, the *yilescz* were members of the master race, which scorned them. Words for *yilesc* and *kewl* did not occur in the *ol* language, and what the *olz* thought of them was not yet fully understood. Certain it was that the *yilescz* fulfilled some unknown function, either spiritual, physical, or social; that every *ol* village had a hut reserved for them; and that while there was doubt as to which needs of the *olz* were served by the *yilescz*, there was no doubt whatsoever that the *olz* had no one else to serve them.

Not even the aristocrats possessed the freedom of movement of a *yilesc*. It was assumed that some ancient *kru* had honored the *yilescz* with his patronage, and a few vestiges of that royal favor had survived the centuries. The apprentice was apparently optional, a girl of the *yilesc's* own race who was bought, borrowed or stolen from the most lowly of city commoners. The *yilesc* invariably traveled with a male *ol* servant, making her kind the only private slaveholders in Scorvif. She possessed by right a *narmpf* and a cart. When her *narmpf* died, or her cart wore out, any *durrl* was traditionally bound to furnish a replacement. In the blunt realism of Branoff IV existence, few *durrlz* paid any attention to a tradition that involved only the well-being of the despised *yilescz* and by extension the scorned *olz*. The *yilesc* who lost her transportation was likely to walk until some *durrl* suffered an unaccountable twitch of generosity or perhaps thought to buy her influence to improve the work quota of his *olz*.

The roles of *yilesc* and *kewl* were made to order for a team of IPR agents. Not only could they travel freely, but as long as they stayed away from the cities and avoided the *kru's* soldiers they had what was, for that violent world, an unusual degree of safety. IPR specialists quickly discovered *whom* the *yilescz* were, but after years of study and the successful placement of a number of *yilesc* agents, they



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had no notion at all as to *what* they were.

If they were priestesses they had no discernible religious function. If they were witches they practiced magic to no apparent purpose. If they were seeresses they did not prophesy. And if they were peregrinating medicine women, Dr. Garnt would observe sourly, they did not heal. They simply were, and the mysterious uniqueness of their existence had made the specialists speculate as to whether they might occupy a pivotal position in the Branoff IV social structure. Supreme Headquarters had been asked for an agent with special qualifications for the role of *yilesc*, and Supreme Headquarters sent Liano Kurne.

She had been instantly and tremendously successful, and both Jorrul and the coordinator had thought that the solution to the mystery was within her grasp. Then tragedy struck. Liano recovered; her mind did not. She still had no recollection of what had happened. Probably she did not want to recall.

And she could not or would not tell what she had learned.

As the night deepened, the *ol* women and children withdrew from the fire and gathered in the outer shadows in a mystic communion that defied Farrari's understanding. Only then would Liano leave her hut and join them. Her work was with the women and children, and when she cared for a sick male it was, except in times of epidemics, because a woman requested it. The children loved her, and she played tirelessly with them, performing sleight of hand tricks with a shining pebble or a twig. She brewed mysterious drafts for them, performing incomprehensible incantations over clay bowls of steaming liquid and at the same time surreptitiously lacing the drinks with vitamins.

Unlike the men, the women babbled incessantly. Undoubtedly it was they who kept their language viable, but Farrari had no inkling of what they talked about. When he asked Liano she smiled mysteriously and did not answer.

Farrari huddled in darkness far from the warmth of the fire, watching Liano, tensed to leap to her side when she beckoned. As a *kewl* he was lowest of the lowly, perhaps because he served a woman, and all of the *olz* ignored him, even the children. They made room for him at the fire only when he approached it on an errand for Liano. As there was little for him to do, he watched, and listened, and meditated.

He had not thought it possible that a society could be so utterly barren of culture. The lifeless phonetic symbols of the IPR Bureau were the only written form of the *ol* language, but even a people without writing should have had an



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oral tradition of myth or history. The *olz* had none. They had no storytellers or minstrels, and for all of the incessant woman talk, Farrari never heard a woman croon a lullaby. With their crude sticks they scratched the soil for twice-a-year plantings, but it had never occurred to them that those same scratches might be utilized to communicate or represent.

How does one raise a cultural level, Farrari demanded of himself, when there is no culture to start with?

But the IPR base, and the talk of oh-ohing the planet and a two-thousand-year hiatus were remote almost beyond memory as Farrari watched the male *olz* around the oily, reeking nightfire. There was no laughter among them—not even the children laughed—and Farrari vainly searched the taciturn *ol* faces for one fleeting glimmer of an illusive, inward-turning smile. In this, the most favored season of the year, they seemed neither happy nor unhappy. If there was joy in their lives they concealed it well; in another season they probably concealed their misery.

The *olz* existed; *why* they existed seemed no concern of theirs.

Farrari had expected to find a grim, barren land. Instead they moved through pleasantly shaded, fragrant lanes, for even the deadly *zrilm* shrubs put forth large blossoms that hid their vicious needles under exquisite splashes of color. There were thick *zrilm* hedges, taller than a *durrl* mounted on a *gril,* that completely enclosed the fields and could be passed only with portable stiles. These ramshackle constructions of pegged boards had a platform at the top from which a *durrl,* or his assistant, could view the work in several adjoining fields. Every harvested tuber, or basket of grain, had to be laboriously carried over one or several *zrilm* hedges to the waiting wagons, and at night the *durrl* carried away the stiles. A system of gates would have greatly lessened the *ol's* toils, but gates would have been much more difficult to guard. The *zrilm,* the symbol of the *ol's* bondage, was also the symbol of his hunger. No starving *ol* had ever been known to force his way through a *zrilm* hedge: starvation was the easier death.

Farrari saw *durrlz* rarely and then only at a distance, for they almost never visited an *ol* village. The *olz,* even the youngest children, went to the fields at dawn and returned at dusk. Farrari had a leisurely, tedious day, followed by a few hours of excruciating alertness at the nightfire when he prepared Liano's food, ran errands at her bidding, restrained a feverish child while she performed a rite of health over it, looked after the *narmpf,* and finally, when the *olz* retired to their huts, he would send his daily report to field team headquarters.



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After two or three nights in a village they moved on, departing in the morning without a leave-taking because the *olz* were already at work, and, before they left, returning to the village stores the pathetic offering of tubers and grain that had been ceremoniously presented to Liano the night of their arrival. They would reach their next stopping place by late afternoon, Farrari would clean out the hut reserved for any visiting *yilesc* and prepare a sleeping place for himself in the open, and they would await the return of the *olz*.

The nights lengthened and became colder. The last of the harvest was gathered, and the day came when most of the *olz* remained in the village. Jorrul thought that Farrari was not sufficiently experienced to undergo the strain of maintaining his *ol* identity continuously, so he ordered them out. They left the next morning and that night base sent a platform to pick them up.

"You've done well," Jorrul told Farrari. "You've learned to act like an *ol*. Now we'll have to teach you to think like one." He added softly, "Liano seems to have done well, too. Did you find out anything?"

Farrari shook his head. They had asked him to be alert for any clue concerning the mystery of the *yilescz*, and since they could give him no notion of what to look for, he doubted that they seriously expected him to find it.

"Would it be all right to ask Liano to marry me?" he asked.

Jorrul frowned. "She wouldn't. Not after what happened. Her husband was literally torn to pieces before her eyes. I'm certain she'd never take to the field again with a fellow agent who was anything more than that. It would impair your relationship if she even suspected that you wanted to marry her, so don't mention it. You can help her most by keeping your work on a strictly impersonal basis."

"Then tell me one thing," Farrari said angrily. "If she has no personal interest in me, why did she choose me?"

"We've wondered about that," Jorrul said. "We're still wondering, but with things going well we're not about to upset them by asking questions." He changed the subject with a shrug. "I take it that you didn't encounter any difficulties."

"Once my muscles got resigned to my moving like an *ol*, I spent most of the time feeling bored."

"That's because you weren't thinking like an *ol*."

"How can you tell how an *ol* thinks?" Farrari demanded.

"We can't," Jorrul admitted. "The most we can do is reason from our observations. We know how an *ol* ought to be thinking. He has so little leisure time during the agricultural season that if he thinks at all he must envy you yours. Maybe that's why a *yilesc* is never



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without a *kewl*. If she loses one she can replace him at any village, probably with the first *ol* she asks."

"After what I'd been led to expect, it was almost a letdown," Farrari said. "I saw no beatings, no starvation, and very little illness. I rarely saw a *durrl*, and if there was any danger I certainly didn't notice it."

"On your first field assignment we wouldn't put you where there was *much* danger. In the outlying districts the *durrlz* are more humane, probably because they aren't likely to be ambitious or they wouldn't be there. Also, fall is the healthiest time of the year. The weather is mild, and the *olz* always eat well during the fall harvest. The sickly are already dead and the well will probably remain well until winter sets in. When you go back you won't have it so easy. This is the year of the half crop, and that means . . . you'll find out what it means."

## XI

It meant the spring of starvation.

In the year of the half crop, half of the arable land lay fallow. A full harvest followed, and then came another half crop while the remainder of the land was rested. It was a crude and fiendishly cruel method of preserving the land's productiveness. Regardless of the size of the harvest, the master race took what it wanted, kept its emergency storehouses filled, and enjoyed full rations. And in the year of the half crop the starving *olz* died by the thousand.

Farrari and Liano were scheduled to spend the winter in advanced training and return to the field at the beginning of spring; but the cold weather lingered, the rains were heavy and unrelenting, and Dr. Garnt glumly posted reports of death and sickness from IPR's scattered *ol* agents and pronounced the weather the worst of any spring on record.

The coordinator sent for Farrari. He and Peter Jorrul had been reviewing the doctor's reports, and they looked as though they were about to invite Farrari to his own funeral.

"All of this information," Jorrul said gravely, "comes from places where our agents have been secretely fortifying the *ol* diet all winter. And if *those* natives are dying at this rate, we hate to think what's happening elsewhere."

"We hate to think," Coordinator Paul added, "but we'd like to know. We've got to know, and we've got to do everything we can to help them. I'd planned to keep you here until the weather breaks, but—"

"I understand, sir," Farrari said. "If it's all right with Liano, I am ready to leave whenever you can arrange it."

"Batting about in an *ol* loin cloth in this weather won't be



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pleasant," the coordinator said. "What *are* you grinning about?"

"When I started this," Farrari said, "I had that silly notion about bringing culture to the *olz*."

They had the crushing sensation of walking in the footsteps of Death. Outwardly life seemed to continue as usual. The *olz* who were able gathered around the nightfire, but these were transformed *olz*, with blanched flesh stretched tautly over sharp bones and so weak were they that four of them struggled to lift a log onto the fire. They huddled in the shallow circle of warmth for hours without uttering a sound. Now even the women were silent.

The *olz* were unable to maneuver the pathetically light bodies of the dead through the narrow doorways, so dead and dying lay together in huts foul beyond belief with the accumulated filth of winter. Farrari and Liano carried the dead to the death huts, cleaned and cared for the sick, and secretely added powdered nutrients to the watery soup compounded of the last of the village's stock of rotting tubers. They had no hope at all that this would give the living the stamina they so desperately needed to survive until the weather improved, but in one day they could do no more. At dawn they were on their way to the next village.

And again Death had come before them.

Each day brought another village, another pile of dead, another cluster of pathetic, starving *olz* about a nightfire. Farrari lost track of time. They were both near exhaustion when they haltingly made their way across a finger of the vast clay wasteland that remote centuries of careless agriculture had devastated. When finally they neared the other side and pointed their way toward a fertile valley, the *narmpf* sighted *zrilm* hedges that promised dry leaves for it to munch and increased its floundering pace with an impatient snort.

Suddenly Liano cried out. Farrari halted the *narmpf* with a slap of his hand and turned. An *ol* staggered toward them. His taut skin had the unhealthy, pasty pallor that all of the *olz* had taken on during the winter months, but with an ominous difference: even at a distance Farrari could detect an ugly flush of fever. The *ol* stumbled and fell as he approached them and lay motionless.

Farrari ran to his side, and Liano leaped from the cart and followed him. The *narmpf* snorted again, this time in alarm, and shifted its feet nervously.

The *ol* was dead. They carried his frail body to the cart, and Liano gently touched a puffed ridge of flesh that ran the length of his spine. "I've never seen anything like that," she whispered.

Farrari turned the *narmpf* aside, and they retraced the *ol's* steps,



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skidding down a last, steep slope—Farrari wondered awesomely how the dying *ol* had managed to climb it—and turning into a narrow lane lined with tall *zrilm* hedges. A short distance farther on they came upon the village, with its circle of low clay huts about the fire-blackened hollow where the clay cooking pot stood, and, nearby, the clumsily-dug well and a pile of water-soaked *quarm* logs.

The logs were a danger signal. *Quarm* was strictly rationed, the *olz* never had enough, and they kept their meager reserve in storage huts. The soggy logs meant that this village had not had a fire for many nights, and that meant serious trouble.

Farrari crept under the cart for shelter from the driving rain while he lit a torch, and they went quickly from hut to hut. All of the *olz* had the strange swelling on their spines. More than half of them were already dead. Farrari muttered, "They're so weak from hunger that they have no resistance."

"We'll need help," Liano whispered.

He stood guard while she talked with base. Then he violated a fundamental rule of *ol* existence—fires permitted only during the hours of darkness. He dragged dry *quarm* logs from the storage hut and started a roaring blaze around the clay pot. While the water heated they carried the dead to the death huts, splashing through thick, oily smoke that hung near the ground over yellowing puddles. The death huts were quickly filled, and they laid the overflow to rest in a neat row beside them.

The miracle was that so few of them were children. He mentioned this to Liano, and she said, "During the winter, the children eat first."

Farrari cleaned accumulated filth from the empty huts, and when the water had heated Liano transformed some of it into a nourishing broth with a sorcery no native *yilesc* could have achieved. They bathed the living *olz*, forced broth past their fever-swollen lips, and carried them to clean huts.

When darkness came on Farrari moved the cart to the edge of the wasteland and turned on a direction signal. A short time later an IPR platform floated down. Dr. Garnt clambered over the side, muttering, "So you've got yourselves a situation."

"Is that what you call it?" Farrari asked glumly.

When they reached the firelight he had to laugh in spite of his dark mood. The portly doctor was ineffectually disguised in an *ol* loin cloth. "If a *durrl* sees you, he'll make four *olz* out of you," Farrari hissed.

"I didn't have time to diet," the doctor whispered sourly.

The platform's pilot, one of Isa



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Graan's men, helped Farrari to unload supplies. They packed in as much as the cart would hold under its false bottom and concealed the remainder behind *quarm* logs in a storage hut.

Dr. Garnt returned to the platform swearing softly to himself. "Some damned virus," he whispered to Farrari. "This world has already given us some choice specimens, but we haven't encountered this one. Did you notice the inflammation along the spine? Nasty. Put up the tent and I'll go to work."

They stretched a tent over the platform, and the doctor fussed and muttered and clanked equipment for hours until Farrari anxiously began to watch for the dawn. Finally he emerged with a flask of clear liquid.

"It complicates things, having to give it to them orally," he explained. "But I'd be cashiered and sent home if I started mass injections. That doesn't apply to you, of course. Let's have your arm."

He inoculated Farrari and Liano and delivered terse instructions about the antitoxin he'd concocted. Graan's man muttered about the time and took off while the doctor was climbing aboard. "Have you checked the neighboring villages?" he called. "Better do that. We'll start mass-producing this, just in case. I'll be back tonight." The platform vanished into the thinning darkness.

Liano crept into the *yilesc's* hut for some badly-needed sleep. Farrari continued to make the rounds of the huts, this time coaxing the swollen lips to accept Dr. Garnt's medicine. A gray day pushed aside the gray dawn; the rain changed to wet snow and the wasted bodies of the dead lying outside the death huts were mercifully cloaked in white shrouds.

A distant, sputtering bray brought Farrari scrambling from a hut. Through the snow he dimly saw, on the skyline where the dying *ol* must have seen them, a *durrl* mounted on a *gril.* Farrari watched uneasily until he passed from sight. The smoke from the forbidden fire still hung near the ground, and Farrari could only hope that the *durrl* had not seen it; but a short time later he heard the braying close at hand and the *durrl* rode slowly into the village.

He halted, looking down at the fire, and Farrari instantly averted his eyes. An *ol* did not look directly at a *durrl.*

The *durrl* grunted an *ol* word. "Sickness?"

"Much sickness," Farrari said.

At a nudge from the *durrl's* knee the *gril* reared gracefully and started away. Suddenly the *durrl* saw the *yilesc's* cart and *narmpf.* He leaped from the *gril* with a bellow of anger.

Liano stepped from the hut and bowed her head respectfully. He started toward her.



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Then he saw the long row of snow-shrouded dead. He strode among them, scattering the snow and now and then kicking at a wasted body. He whirled and ran toward Liano. His sputtering rage left him momentarily speechless, and when he found his voice he screamed incoherently, but there was no mistaking the fury that throbbed in every choked syllable. Liano faced him calmly, eyes downcast.

He leaped to the waiting *gril,* snatched his *zrilm* whip, and with all of his strength brought it whistling down on Liano.

Farrari had started forward when the *durrl* reached for his whip. It was in its downstroke when he seized him from behind and jerked him backward. The dry leaves no more than brushed Liano's robes, but they raked Farrari's leg with excruciating pain. He hurled the *durrl* to the ground, secured the whip, and slowly backed away, his leg dripping blood onto the snow.

The *durrl* dazedly regained his feet. He said nothing; the shock of being attacked by an *ol* left him not only incoherent, but almost comatose. Farrari calmly tossed the *zrilm* onto the fire and turned to confront him. Looking a *durrl* in the eyes for the first time, he had the inward apprehension of having unleashed a clap of doom, but he could not resume the subservient posture that his role demanded.

He could not think like an *ol.*

A *gril* raced down on them with a patter of small hooves. Farrari whirled, caught the flutter of gold-embossed robes, and hastily lowered his eyes. Doom had arrived, and he felt more astonished than apprehensive.

An aristocrat, in this remote *ol* village!

The *durrl* was as dumbfounded as Farrari. He stared for long seconds before he remembered to avert his eyes.

The aristocrat halted outside the circle of huts, a shout rang out, and the *durrl* approached him haltingly. A question was flung in harsh *Rasczian* syllables, and the *durrl* began a stumbling reply. They were too far away for Farrari to understand what was said, but it was obvious that the *durrl's* explanation did not sound convincing, even to him, and his discomfiture increased as he fumbled for words. Farrari enjoyed the situation while he could; his own turn would inevitably follow and there was no justice for an *ol*—only greater or lesser punishment.

The aristocrat snarled a reply that ended with a rasping command. The *durrl* turned silently, mounted his *gril,* and rode away.

The aristocrat turned his back on Farrari and Liano, made a sweeping motion that could not be misunderstood, and rode away. Obeying his unspoken command they followed him on foot.



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He led them a short distance along the hedge-lined lane and turned, flourishing a spear. Farrari tensed himself to dodge or attack.

The aristocrat leaned forward. "Of all the idiotic things to do—are you trying to blow the planet?"

Liano said quietly, "Hello, Orson."

"What sort of indoctrination did this halfwit have?" the aristocrat demanded. "An *ol* assaulting a *durrl!* Why, that's . . . that's—"

"Sacrilege," Liano murmured. "Cedd, this is Orson Ojorn."

"What was I supposed to do?" Farrari demanded angrily. "Let him use that damned whip on her?"

"Yes," Ojorn snapped. "That's exactly what you were supposed to do. When you have an *ol* role you behave exactly like an *ol*—or you get recalled and buried in an office job on a nicely-controlled world where your impulsiveness isn't likely to embarrass anyone. And that's what'll happen to you as soon as I report. Assaulting a *durrl!*" He waved his arms wildly. "You could have blown the planet and got the entire team demoted five grades. It's a good thing Peter sent me to observe you two."

"What's going to happen?" Farrari asked.

"You'll be recalled. Expect a contact as soon as it's dark."

"We're already expecting a contact. I meant—what'll the *durrl* do?"

"Nothing. I've instilled in him a lifelong respect for *yilescz*. If I hadn't been here—"

"We have work to do, Orson," Liano said. "The *olz* are dying."

"I know. Go back to work, then. I'll tell base to send you another *kewl*."

He rode away, and Farrari and Liano walked back toward the village.

"I thought there weren't any agents among the aristocrats," Farrari protested.

"There aren't," Liano said, "but there are a few aristocrat agents. They can get away with it as long as they stay away from the real aristocrats. Sometimes they can be very useful."

"Obviously. Could you understand what he said to the *durrl?*"

"He said enough to frighten him badly. He reminded him that a *yilesc* has the protection of the *kru* and threatened to hold him responsible for the sickness if we were interfered with."

"I see."

"He would have whipped me," Liano said softly.

"He certainly gave every indication of it. Why, by the way?"

"He'd already started. He would have whipped me."

Abruptly she lapsed into a mood he had not seen for months; her manner was subdued; her gaze directed absently at nothing on the horizon. And when they returned to work she performed her tasks me-



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chanically and spoke not at all. Farrari did not disturb her. His leg was still bleeding and he could not bandage it—no *ol* would wear a bandage. It throbbed painfully, but he knew that it was not even a sample of what a real beating would be like.

And Liano, he feared, had her own vivid memories of that.

He worked at her side, wondering bitterly if a sick *ol* was any more susceptible to culture than a well one, because on this, his last day in the field, the only *olz* available for him to work on were dying.

But when Dr. Garnt came that night Farrari's recall was not even mentioned.

There was sickness in the next village. And the next. For days they labored, moving from village to village, covering as much territory as they could but not nearly enough, fanning the feeble sparks of life that they found in the foul, damp coldness of the huts. Base, in a frantic attempt to halt the spread of the strange virus, sent all of its *ol* agents into the area and everyone else who could by any stretch of the imagination pass as an *ol*. The latter were less than adequately trained, but the *durrl* never reappeared and the *olz* were too sick to care whether their nurses walked properly.

In every village the piles of dead grew daily. Soon there were more dead *olz* than there were live *olz* being cared for. When Farrari suggested that they dig graves, Liano solemnly shook her head. A village's dead were its own business.

"Come warm weather, these villages aren't going to be pleasant places," Farrari objected. "And what if there's no one alive in the village to take care of them?"

"Then the neighboring villages will do it."

Farrari grumbled for days before abandoning the argument.

The unseasonably cold, damp weather passed, finally, and one of the *durrl's* assistants brought a generous ration of food to each village. Farrari was touched by this humanitarian gesture until Liano explained that every *durrl* held back a reserve of food for spring, just in case the *olz* needed it to give them sufficient strength for the spring planting.

"Just in case they need it!" Farrari exclaimed.

"This year they'll have more to eat than usual," Liano observed soberly. "There are so few . . ."

The sick *olz* soaked up sunshine, ate, became stronger. The crisis had passed, but in the villages afflicted by the disease, only one *ol* in six survived.

Farrari and Liano left, as usual, without a murmur of farewell. That night a platform met them in the wasteland and whisked them and their *narmpf* and cart to base for a rest.



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Coordinator Paul greeted them, shook their hands warmly, and said, "Well, Farrari, what progress in disseminating culture?"

"Culture?" Farrari echoed bitterly. "We couldn't even keep them alive!"

The coordinator nodded. "Very well put. Before the *olz* can concern themselves with things like democracy and culture, they have to achieve survival."

Later Peter Jorrul came to Farrari's workroom and greeted him with such evident embarrassment that Farrari opened the conversation by saying resignedly, "I suppose my career as an *ol* is finished."

Jorrul nodded. "No one regrets that more than I do. You did well enough to astonish a lot of people, including myself, and for a time we thought we'd found a natural agent in the most unlikely place imaginable. But—" he smiled tiredly—"you have a fatal weakness."

"I can't think like an *ol*."

"Right. I'm extremely glad that you can't, since no harm was done. You saved Liano and quite probably yourself, and you enabled us to learn something. In this business one survives by learning—if one learns quickly enough to survive."

"What did you learn? That CS men can't think like *olz*?"

Jorrul said ruefully, "At least we could have been excused for not knowing that. 'Learned' isn't the right word—you brought to our attention something we should have observed years ago: the *yilescz* vanish at the end of the harvest season and have nothing to do with the *olz* until spring planting. Why this is so we have no idea. We possibly would have deduced this earlier if Liano had been able to tell us what happened when her husband was killed. We should have figured it out anyway, but we didn't."

"That happened at the same time of year?"

Jorrul nodded. "A spring of starvation. A *durrl* found her and her husband in an *ol* village looking after the sick and dying, and he used a *zrilm* whip on them." He paused. "If it's any consolation to you, we think Liano's husband also had difficulty in thinking like an *ol*. He probably interfered, as you did, when the *durrl* attacked Liano. Then he submitted to a beating and was killed, and because that satisfied the *durrl's* anger somewhat, Liano survived."

"Do the *durrlz* want the *olz* to die?" Farrari demanded.

"The contrary. The only conceivable explanation is that the *durrl* thought you were killing *olz*, not keeping them alive. The science of medicine doesn't exist on this planet, and neither the *olz* nor the *rascz* have any concept of the healing process. From spring planting through the fall harvest the *durrlz* don't seem to care what the *yilescz*



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do, perhaps because not many *olz* die during those months. But in the spring following a half-crop year the death rate is horrible, and this is one time the *durrlz* must worry about their *olz*. They're harassed individuals with an impossible task to accomplish. They have the responsibility of maintaining the food supply, and they have to do it with unbelievably primitive agricultural methods, exhausted soils and degenerate strains of food plants. When they fail to meet their quotas the penalty is usually catastrophic. So if a *durrl*, never mind how or why, gets the idea that a *yilesc* is killing his *olz* to a point where there won't be enough left for the spring planting, his reaction will be instantaneous and furious."

"Which it was," Farrari agreed. Jorrul nodded. "There are so few *yilescz*, and they operate so illusively, that we simply never noticed that there is a season when they don't operate at all."

"After I'd demonstrated that I couldn't think like an *ol*, why did you leave me there?"

"You were needed," Jorrul said. "We had to keep that sickness from burgeoning into a full-scale epidemic, and to do that we had to make use of everyone who had any competence at all. Any more questions?"

"How is Liano?"

"Excellent. Eager to go back. We owe you more than thanks and congratulations, Farrari. The coordinator has recommended a second promotion for you, which is against regulations because the one he recommended after your Scorv adventure hasn't come through yet. I hope you enjoy the full satisfaction of having done an excellent piece of work for us, because you deserve it. You've also acquired experience that few CS men will ever have, and you got what you wanted—a chance to study the *olz*. Did you find out what you wanted to know?"

"I didn't know what I wanted to know," Farrari said gravely. "I still don't."

"Dr. Garnt says if you'll stop by this afternoon he'll remove your *ol* profile."

Farrari rubbed his forehead. "There's no hurry. For a long time I couldn't believe it was I, but now I'm used to it. Pehaps it would be a good idea to have an *ol*—someone who looks like an *ol*—here at base. The base staff is as much in need of a reminder that *olz* exist as the *rascz* are. Maybe I'll make that my next project."

Jorrul chuckled. "All right. You can keep your profile and remind the staff that *olz* exist. Your Scorv adventure had another result. The priests have decided to treat your temporary presence in the Life Temple as a supernatural visitation. Your relief portrait has been mounted near the *kru's* throne in the Life Temple and the palace, and they aren't going to appoint



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another *kru's* priest. What do you think of that?"

"I won't know whether it's a compliment or an insult until I see the carvings. Did you get teloids of them?"

"No, but we'll try," Jorrul promised. He must have been in one of his rare good moods, because he departed laughing.

Farrari slept for a day and a night, awoke to find that a stomach conditioned to *ol* food had no appetite for an IPR breakfast, and slept again. His exhaustion left him, to be immediately replaced by boredom. There had been few changes at base. Heber Clough was grappling with a weighty geneological problem: the old *kru's* fourteenth son had inherited the throne; the new *kru* had only three sons. As Farrari walked past his door Clough waved and wailed after him, "What happens when a *kru* dies before he has fourteen sons?" Thorald Dallum excitedly beckoned him in to see a plant mutation. To Farrari it looked like a sprig with a couple of withered leaves. Semar Kantz, the military scientist, had completed his studies and been transferred. Jan Prochnow's faded notice, "*Yilesc*?" was still posted.

Where life at base had once been irritatingly placid, Farrari now found it utterly stagnant. He attempted to concentrate on the teloids of the interior of the Life Temple, and several times a day he administered a vicious kick to his teloid projector.

When next he saw Liano, he asked her to marry him. She gave him a shy, startled look, edged away fearsomely, and blurted, "Oh, no!"

And fled.

A few days later he heard that she'd returned to the field.

With another *kewl*.

She had loved him, he thought, from the depths of her sickness, and his love for her had grown steadily; but as she became well, had her love also undergone a cure?

If it had, Farrari blamed the roles they had enacted. They played their parts only too well—she the remote seeress, he the groveling slave. In all the countless hours they had been alone together in the field, he had never emboldened himself to so much as touch her hand. A *kewl* would not dare to touch the hand of his *yilesc*.

A *yilesc* would not—could not—marry a *kewl*. The work that should have united them had separated them irreconcilably.

He attempted to submerge himself in work, and he began to summarize his impressions of the *olz* and to use them to test various theories, his own and those of other specialists: but his impressions were discouragingly sketchy and none of the *ol* theories seemed to have any connection with the sick *ol* in a



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filthy hut, or the pile of snow-covered dead outside.

On Peter Jorrul's next visit to base, Farrari sought him out and said, "The *olz* have very little communication between villages. Have any local differences developed?"

"What sort of differences?" Jorrul asked.

"Dialects, customs . . ."

Jorrul shook his head.

"The coordinator once told me that it would take years for an idea to spread from one end of the country to the other among the *olz*."

"Assuming that the *olz* ever have an idea that they'd want to spread, that would probably be true. I doubt that they do."

"In that case, why haven't local differences evolved?"

"I don't know." He strode to the wall and scowled at a map of Scorvif. Scattered markers designated IPR field agents. Liano was working in the *yomaf*, the most remote finger valley. The markers for the twenty *ol* agents looked very lonely indeed. "The question," Jorrul said, "is whether our agents are placed where they would encounter differences if there are any. We need more people south of Scorv."

"That isn't the question at all," Farrari said. "The question is whether any of these agents have enough knowledge of the whole country to recognize a local difference if they were to see one. If you keep them pretty much in one location . . ."

"I see what you mean," Jorrul said. "We'll think about it. Are you looking for something in particular?"

Farrari shook his head. He had only an unfocused realization that something was very wrong with IPR policy, that his work was crippled by a slavish adherence to regulations that were conceived with no thought of the needs of Branoff IV. He had no idea what should be done about it, but he did know that his days in the sterile confines of the base were numbered. He had tasted life, the life of the *olz*, and dedicated himself to doing something about it. If he could not return to the field, he thought he should ask for a transfer.

Days passed.

Peter Jorrul came to his workroom, seated himself, and announced gloomily, "Liano has disappeared."

Farrari was startled to find that he was not surprised. He said, "What happened?"

Jorrul gestured forlornly. "She must have run off. The agent acting as her *kewl* saw her to her hut and turned in himself. In the morning she was gone. It's as safe a region as exists anywhere—not *rascz* about except the *durrl* and his establishment, and there's no reason why he'd interfere with a *yilesc* at this time of year. Certainly the *olz*



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didn't abduct her. The question is whether she had a relapse and wandered off, or whether she did it deliberately."

"Even if she had a relapse," Farrari said thoughtfully, "she still could have done it deliberately."

"What do you mean by that?"

"Just what I said. What are you doing about it?"

"Nothing, except to pass word to all of our agents to be on the lookout for her. An effective search would require more people than we'd dare to use anywhere except in Scorv. Did you notice anything that suggested that she might do something like this?"

"Not at the time, but in retrospect—yes. You should have been able to predict it."

Jorrul stared at him.

"What's a *yilesc*?" Farrari asked. "No one seems to know for certain, but everyone agrees that there's something out of the ordinary about her. Witch, female shaman, seeress, and sorceress are a few of the terms the specialists use. Has it occurred to anyone that the genuine native *yilesc*—who may have many native imitators who are nothing of the sort—might be some kind of clairvoyant?"

Jorrul continued to stare.

"And," Farrari went on, "when you send an IPR clairvoyant to play the role of *yilesc*, who is a native clairvoyant, there's a grave danger that she might actually become one."

## XII

At irregular intervals one of the base's supply platforms took off at dusk to fly a leg of the ESC, the Emergency Supply Circuit. Since IPR agents lived as natives they had little need for supplies, but Jorrul had scattered secret emergency caches about the country, and Graan's men visited these occasionally, checked the inventories, and replaced what had been used. On the wall of Graan's office was a chart showing which leg of the circuit had been flown last, which leg would be flown next, and when.

It was a simple matter for Farrari to duck into the hangar when no one was about, squeeze between crates, and pull a tarp over himself. It was almost dark when the platform took off, and the thick blackness of the Branoff IV midnight enveloped its first landing. While Graan's infra-goggled assistants worked to open the hidden entrance of the cave where supplies were cached, Farrari went over the opposite side of the platform and vanished into the night.

He wore only the *ol* loincloth; he took nothing with him except a small knife. He covered ground as rapidly as he dared, cautiously feeling ahead of him with a staff cut from a young *quarm* tree to avoid walking into *zrilm* bushes, and when dawn broke he was moving along a *zrilm*-lined lane near an *ol* village. He needed a place of ref-



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uge—when he was missed someone might think of the supply mission, and he wanted to be as far from the emergency cache as possible before he permitted even an *ol* to see him. Thoughtfully he contemplated the deadly curtain of *zrilm* foliage. He parted it with his staff, slipped under it, and let it drop behind him.

He found himself in a delightfully snug and roomy hiding place, and the discovery confounded him. The supposedly impenetrable *zrilm* barrier could be breached by any *ol* with a stick and the intelligence to use it. Why, then, he asked himself bewilderedly, didn't the *olz* raid the fields on harvest nights and conceal a food reserve against the annual season of starvation?

Unanswerable questions no longer perplexed him as they had in the beginning, because there had been so many of them. He composed himself on the damp, musty soil and concentrated on his own plans.

Liano's disappearance had prompted his own. Since Jorrul had made no search for her, he would make none for Farrari; and if, contrary to reason, he did make an active search, he would assume that Farrari had gone to look for Liano, and he would concentrate on the *yomaf*, where she had disappeared.

The *yomaf* was the one place Farrari would not go. He would head up the *hilngol*, the finger valley on the opposite side of the Scorvif hand. Precisely what he would do there he had not decided, except that if he did formulate a plan, he had promised himself not to check it against the IPR field manual before putting it into effect.

He slept through the day, moved on at nightfall, and sheltered himself in another *zrilm* hedge at dawn. He slipped past villages in the darkness, cautiously making a wide circuit of the nightfires and drinking at village wells only after the *olz* had retired. In five nights of steady walking he put the *lilorr* behind him and began to make his way up the *hilngol*.

His conditioning as an *ol* had inured him to hunger, but the time came when he had to eat. He approached a nightfire hesitantly squatted there, cupped his hand to scoop watery soup from the cooking pot. No one paid any attention to him. He eased his hunger as well as an *ol's* hunger could be eased at that time of year, and when the *olz* began to drift off to their huts to sleep he quietly made his departure.

After similar experiences at a dozen nightfires, he became sufficiently emboldened to find an empty hut for himself and remain at a village overnight. In the morning he accompanied the *olz* to the fields and spent the day cultivating the tender young tuber plants by hand. The *durrl* appeared at midday, watched for a time from the



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stile platform, and then departed. Farrari moved on that night, spent a few days in another village, moved again.

He had another perplexing question to meditate: if an *ol* could move about so easily, why did the *olz* complacently remain where they were until disease, starvation or a beating killed them? Venturesome *olz*, moving alone or in small groups, should have been able to escape through the mountain passes to freedom. Why did they remain?

In one village he encountered a *yilesc*. His momentary thrill of recognition was instantly dampened when she turned a plump, cruel-looking face toward him. All evening he surreptitiously watched her and her *kewl*, and when finally he retired he was in a thoughtful mood. Her behavior was nothing like Liano's. She did nothing at all, remained aloof to men, women and children, and her *kewl* cringed in terror whenever she snarled a request for food or drink.

Another village. From his place by the fire, Farrari looked across at the women and children and watched the light flicker on the somber, young-old face of an *ol* child. Picking up a twig, he absently began to sketch her face in the packed soil. A grunt with an unusual inflection caused him to look up; several *olz* were watching his twig strokes intently. He quickly altered the scratches into an unrecognizable jumble and then rubbed them out. The *olz* lost interest and moved away, but Farrari, though he could not have said why, felt shaken. Could the *olz*, who possessed no art at all, instantly recognize the mere beginnings of a three- dimensional figure depicted on a flat surface? And why had he destroyed the drawing when they seemed to do so, since he considered it his mission to bring culture to them? He sensed a missed opportunity, and began to sketch again, but the *olz* were already drifting off to their huts.

A few nights later, in another village, an *ol* carrying a log to the fire stumbled and went head first into the huge cooking pot. The pot contained only water and did not break; the fire had not been lit. The *ol* came up sputtering bewilderedly but otherwise unharmed, and long minutes afterward he was still sending searching glances at the ground about the fire hollow, as though trying to identify the evil spirit that had tripped him. The *olz* who saw what happened seemed not to notice.

Seated by the fire that evening, Farrari, on an impulse, felt about for a twig and drew an *ol* carrying a *quarm* log. He made a simple stick figure, with an oval for a head, carrying a crudely three-dimensional log. Then he added a circle for the yawning opening of the pot and surrounded it with the logs of an unlit fire. Were any of the *olz* watching? He feared that



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they were and that they weren't; he did not dare to look.

He edged to one side and commenced again: the log flying, the stick figure, head down in the pot with feet in the air. Now he heard a chorus of grunts. He moved away, and the *olz* crowded in to see what he had made. They looked, but he could not guess what they saw, and he detected nothing in grunt, facial expression, or gesture that revealed what they thought.

Their interest waned quickly. As they drifted away, Farrari returned to the sketches and with a few quick strokes transformed the crude figures. Now they wore the serrate-topped boots and fringed cloak of a *durrl*. The men came for another look, and then the women and children shyly edged forward. For the remainder of the night, until they sought their huts and sleep, the *olz* kept returning to look at these strange scratches in the soil, and when they walked past them they made a wide circuit to avoid stepping on them. Finally Farrari was left alone at the fire, and after some deliberation he rubbed them out.

Farrari felt certain that he had accomplished something, but he had no idea what it was and no certainty that he would ever know. So engrossed was he as he slowly moved toward his own hut that when an *ol* stepped from the shadows and walked beside him Farrari did not notice him until he spoke.

"What are you after?" he whispered.

He spoke Galactic.

He whispered again, "We'd better have a talk," and Farrari nodded resignedly. Jorrul's map had shown no agent in this area, but he knew that *ol* agents sometimes moved about. The prospect of meeting one hadn't worried him, and he wasn't worried now. IPR would not attempt to abduct him from the vicinity of an *ol* village, and this particular agent seemed to pose no threat of any kind. He was obviously elderly, and his body and face were laced with scars that bespoke some horrible encounter with a *zrilm* whip in the remote past. He also had an incipient paunch, which meant that he'd been eating much too well for an *ol*. And he tottered. Even when standing still he tottered. Farrari did not remember seeing him at the fire.

They walked slowly away from the village, and by the time they reached the shelter of a *zrilm*-lined lane the agent was panting and leaning heavily on Farrari's shoulder.

He sank to the ground and asked softly, "You're Farrari, aren't you?"

Farrari did not answer.

"Heard you were missing. I listen to the blah from base every night. And the *olz* said there was a strange *ol* wandering from village to village, acting peculiarly, so I figured it was you. You're the CS



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chap, aren't you? What are you after?"

"I wish I knew," Farrari said. "Who are you?"

The other chuckled. "You wouldn't know if I told you. They crossed me off the books years ago. They think I'm dead. Maybe I am." He chuckled again. "You figured it out, didn't you? I've been hoping someone would be sharp enough to figure it out and have the sense not to blab about it, because I need help. I can't do it alone. I'm too old."

"Do what?"

The agent got to his feet and slyly prodded Farrari in the ribs. "Oh, you're the sharp one. IPR people are too stupid. I was too stupid. I wouldn't have figured it out if I hadn't been killed, and by then I was too old. You're CS, you weren't brought up with your nose in a manual. You *see* things. I heard the blah about you when the *kru* died. I wondered then if you'd figure it out, and when I heard you'd disappeared I *knew*. We've got to work fast. I'm an old man and I haven't much time left. Look. You're going at it the wrong way. I'm old, I can't do it myself, but I know how. Come to my place?"

"Who are you?" Farrari asked again.

"You're right. I should have a name. Call me—call me Bran. This is Branoff IV. Bran's a good name, isn't it?"

"Let me get this straight, Bran. Base doesn't know you're alive?"

Bran chuckled. "If you stay out of sight long enough, base will think you're dead, too. Things happen to agents, especially to *ol* agents. We can't wait much longer, though. I'm old, and I haven't got the time. How'd you figure it out?"

"Figure *what* out?"

"Come to my place," Bran pleaded. "Plenty of time to talk there. I can show you things."

"All right," Farrari said resignedly. "I'll come to your place. I'll never know if I was accomplishing anything here, and I'd like to be shown things."

"Come on, then. We have a long way to go. I had trouble finding you."

They moved off into the darkness. Farrari had become accustomed to traveling rapidly at night, but Bran tottered with small, uncertain steps and had to stop frequently to rest, and they made tedious progress. At dawn they were still far from their destination. Farrari wanted to retire to the protection of a *zrilm* hedge, but Bran dismissed the suggestion scornfully.

"*Skudkru,*" he said. "That's the magic word. Anybody tries to stop you, or interfere, or just get snoopy, tell him *skudkru*. Means *'kru's* messenger'. Even a soldier wanting spear practice wouldn't dare interfere with the *kru's* messenger."



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"It's a *rasc* word," Farrari objected. "Couldn't an *ol* get in trouble using a *rasc* word?"

"No, because *olz* can't say *rasc* words. And we won't get into trouble because when a *rasc* meets *anyone* claiming to be a *skudkru* he doesn't stop to analyze his linguistic capabilities. Interfering with a real *skudkru* is so unthinkable that he likewise couldn't imagine the existence of a phony *skudkru*. It's always worked for me. Of course it wouldn't work except on the road, but there it's perfectly safe." He sighed. "I'm too old for this sort of thing. I miss my breakfast."

He missed his lunch more. They stopped at an *ol* village for water, but Bran disdained the cold dregs of the previous day's thin soup. When finally they reached the destination he sought—a young *quarm* thicket—they seated themselves in the shade and Bran grumbled until he fell asleep, while Farrari anxiously rehearsed an unfamiliar word: *skudkru*.

As he did so, he studied Bran. Small even for an *ol*, of slight build, with a wizened little face that might have had a sly, rodentlike quality had it not been for the mass of thick, crisscrossing scar lines, he would have been an untypical *ol* even without his flabby body. But the *olz* accepted him, and obviously he was able to communicate with them far better than Farrari could. He'd picked up *ol* gossip, and Farrari hadn't known that there was any.

Bran awoke at dusk, and as soon as darkness fell Farrari helped him to drag a small platform from the thicket. Bran broke out a crude-looking, handmade electronic device and monitored base's signals for a time to make certain that none of base's platforms would be in their area that night, and then he donned a pair of infra-goggles and they flew off at treetop height.

"How did you steal this without base missing it?" Farrari demanded.

"Built it myself," Bran said proudly. "Took the parts a few at a time. The stuff that's left at the supply caches, all of it's expendable and nobody keeps any record. An agent needs something, he takes it, and every now and then they check the inventory and replace what's missing. So when I need something I take it. If I need a lot I visit all the caches and take a little from each."

The possibility of this kind of revolt in the ranks of IPR had not occurred to Farrari, and he shook his head in amazement. "You mean you can fly this thing around without base detecting it?"

Bran chuckled and performed an invisible shrug. "Base doesn't operate any detectors. Why should it? As far as it knows, the only things flying on Branoff IV are its own platforms, and it doesn't need to detect them. It knows where they



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are. I fly low anyway, just in case."

They flew on, with the cool night air whistling past them. Occasionally the platform raked a treetop. Twice Farrari saw the glow of an *ol* nightfire in the distance, but obviously Bran was avoiding the villages. They were flying up the *hilngol;* the ground began to rise steeply and the wind became colder.

Abruptly they began a steep ascent only to drop with disconcerting suddenness and land with a staggering thump. Farrari helped Bran push the platform through a dark opening, and then Bran led him along a stone floor and up a ramp, and there was a sound like a door sliding or scraping.

"Home," Bran said, with a sigh of satisfaction. The door closed, and he touched on a light. "Now we can *eat,*" he said. "And sleep. And then we'll talk."

Farrari awoke with a jagged pattern of sunlight lying across his face. He pushed himself to a sitting position and looked about him. He was in a cave, and a crack admitted air and light and, at this particular moment, sunlight. His bed was a pile of straw covered with handwoven robes that would have been a prize exhibit in any Cultural Survey collection. Bran, in a cocoon-like bundle of similar robes, lay nearby, snoring gently.

Farrari got to his feet and padded to the opening. It looked onto a sheltered valley, small but peaceful and lovely. There were several tilled fields and a gently meandering stream. Beyond the fields was lush grass flecked with flowers; high on the surrounding slopes stood a magnificent growth of *quarm* trees. In the distance snow-capped mountains gleamed in the morning sun. In a loop of the stream stood the huts of a small *ol* village; but there were no *olz* in the fields, and the village looked abandoned.

When finally he turned away he found Bran watching him curiously. "How do you like it?" Bran asked.

"It's lovely," Farrari said. "It's too lovely. It doesn't belong on this world. Nature made a mistake."

Bran smiled, his hideous face suffused with delight. "It's mine. I found it when I was looking for a place to heal after they killed me. The only way to get here on the ground is through caves. From the air it looks as though there's a canyon connecting with the outside, where the stream flows, but there isn't. It goes underground."

He scrambled to his feet and took a handlight. "Look—I got storerooms. Been taking stuff for years from the caches, a little at a time." He led Farrari back into the cave: the walls were lined with shelves, and the shelves were crammed. There seemed to be tons of rations and a little of everything



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that an IPR agent could conceivably find use for. Obviously Bran was supplied for life.

"All this," Farrari murmured, "plus a whole village of *olz* to work for you."

Bran shook his head. "They work for me, but they won't stay here."

"Why not?"

Bran stared at him. "You didn't figure it out," he said resentfully.

"I haven't figured anything out," Farrari said.

"I thought you would, you being from CS. IPR people don't know anything that isn't in the manual, and there's nothing in the manual about this. Look—I find this place and I figure it'll support quite a few *olz*. I don't need the grubby food they raise, I'd rather eat IPR rations and I have plenty of that, but I figure the *olz* would like living where they can have plenty to eat and no *durrlz* to torture them, so I dress like an aristocrat and take one family from each village so they won't be missed and bring them here. I also tap the food stocks of all the *durrlz* around here so these *olz* of mine will have plenty to eat until they can make a crop and the best seed and roots for planting. My *olz* build themselves a village and put in the crops and while the crops are growing they start cutting *quarm* up on the slopes, and they have more to eat than they ever had in their lives and because this land has never been cultivated the crops come up like no crops they've ever seen and they can look forward to a warm winter with enough for everyone to eat. So what happens? They run away. One morning my village is empty. They've all gone back to where they came from."

"Maybe they didn't like your mixing *olz* from different villages."

"Bah. Every now and then a whole village dies out during the winter, and that's what the *durrl* does—he brings in one family from each of his other villages, and *they* stay put. So why did they run from my village?"

Farrari shook his head.

"At harvest I bring in another bunch, and they harvest the crops and store them and I think this bunch will be smart enough to see that it has a good thing for winter, plenty of *quarm* to burn and all that food without the *kru* taking one grain or one tuber. So what happens? They run off. They don't take a scrap of food with them, and they go back to villages where there isn't food for half the *olz* already there. *Now* can you figure it out?"

"No," Farrari said. "Nothing about this world makes sense to me."

"At first I couldn't figure it out, either. During the winter I took the food around to the villages that needed it most, and at planting time I got me more *olz* and tried



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again. Same result. That happened for three years. Now I just bring in a few *olz* at planting and harvest time, and a few times in between for the cultivating, and when they've done the work I tell them to beat it. You can't figure it out?"

"No."

"Plenty to eat, they get to keep all the food they grow, no *durrl* to whip and starve them, no soldiers to use them for spear practice, all the wood they want to burn—and they run away. There's only one explanation. They *want* to be whipped and starved and murdered. *They want to die.* They wouldn't stay here because I was keeping them alive."

"That's unbelievable," Farrari protested.

"Sure. That's why IPR'll never figure it out. There's nothing in the manual to cover it. All this blah about democracy assumes that any intelligent being would want to govern himself if he had a chance. IPR can't cope with intelligent beings that are so intent on dying that they don't care what happens to them while they're alive. Even if IPR did figure it out it couldn't do anything because of its silly rules. But I figured it out, and you aren't IPR so you don't care any more about the rules than I do, and together we're going to conquer Branoff IV."

"How?" Farrari asked.

"We're going to make the *olz* want to live."

## XIII

Bran gobbled a package of rations, yawned sleepily, flexed muscles that were painfully protesting his unwonted exertions, and returned to bed. Farrari strolled outside to explore the valley. He followed the stream from the foaming waterfall of its entry to the point where it abruptly plummeted into an underground void and disappeared. Sometime in the remote past a rockfall had blocked the end of the valley, probably creating a lake, and the water had honeycombed the valley walls with caves.

He looked into several of them, wondering if any gave egress from the valley; but he had brought no light with him, so he abandoned the caves and climbed a short distance up the opposite slope. There he stretched out on the soft grass, luxuriating in the warm sunshine and the fact that he could, for a moment, relax and be himself.

He dozed off, to wake with a start when a drifting cloud cut off the sun. Reluctantly he got to his feet and moved on. A short distance down the slope he happened onto another cave opening, and its arch looked so perfectly symmetrical that he went to investigate. The entranceway was as regularly shaped as the opening except for loose rock strewn about on the floor, and the soft stone walls had been lined with slabs of a type of marble Farrari had not seen before.



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Farrari was still pondering the significance of this when he made out, on the smooth, creamy surface of the marble, a carving in low relief. For a long, breathless moment he stared at it, and then he turned and ran.

Bran was still asleep. Farrari gave him a furious shake and panted: "The light! The handlight! Where is it?"

Bran pointed sleepily, and then, as Farrari snatched at it, straightened up and blurted, "What's the matter?"

Farrari shook his head and dashed away. He was halfway across the valley when he heard a shout and saw Bran stumbling after him. He ran on, and when Bran finally came up to him Farrari was standing just inside the cave opening, despondently shining the light on rubble that completely filled the cave a short distance from its entrance.

"What's that?" Bran muttered.

"The ceiling must have collapsed," he said.

"What about it?" Bran panted.

"Look!" Farrari exclaimed. He flashed the light first on one wall and then on the other, and it brought to life a procession of carved figures on either side, marching boldly toward the rubble-choked interior.

Bran gaped perplexedly and finally said, "So?"

"Did you know this was here?"

"No," Bran admitted, and his tone suggested that he wasn't particularly concerned now that he did know. "What's so special about carvings? You can find them all over Scorvif."

"In caves?" Farrari asked.

Bran pawed his hair fretfully. "On buildings, mostly. Don't think I ever saw any in caves. Does it matter?"

"*These* carvings matter. They'd make a lot of base specialists turn handsprings—the historians, the philologists, the archeologists, anyone interested in origins."

Bran looked blankly at the carvings. "What's so special about them?"

"They're carvings of *olz*!" Farrari whispered awesomely. "Don't you see what that means? The *olz* did have a civilization and a highly advanced culture. Their work is more primitive than that of the *rascz*, but at the same time it's more vigorous, more alive and expressive. This also proves that the *racsz* have a tremendous artistry in their own right, but no one has ever doubted that. They began by imitating the people they conquered and eventually surpassed them in many respects. But the *olz* did have a civilization!"

"So how does that help them now?" Bran demanded. "They're still slaves, and they still want to die."

Farrari sat down on a rock and focused the light on the nearest



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carving. "Do they ever commit suicide?" he asked.

Bran dropped onto a nearby rock and flexed his legs. "Muscles killing me," he moaned. "I'm too old. What were you saying? The *olz?* Commit suicide? Not that I ever heard of."

"If they're so intent on dying, why do they wait for those terrible beatings, or for a lingering death by starvation or disease? Why don't they do the job themselves? Surely they could contrive a death that would be quick and painless."

"I don't know. They just don't."

"Don't *any* of them commit suicide?"

Bran shook his head.

"Do you know of even one suicide, or have you ever heard of one?" Farrari persisted.

"No. They haven't the spunk for it."

"What do you mean by that?"

"Branoff IV doesn't have any of those civilized refinements that make for a quick and painless death. It takes gumption to commit suicide in a primitive society, and the *olz* don't have any. How much would you have if for uncounted generations your race had been humiliated and tortured and murdered, men whipped to insensibility and death before their families for the most trivial offense, men having to stand by and watch their wives and children whipped. Any *olz* with gumption would have resisted and been killed when they were first enslaved. Those who could grovel the best survived, and now all the survivors have groveled for so long that they think groveling is all they're fit for. I don't blame them for wanting to die."

"There must be more to it than that," Farrari objected.

"Then why did they run off when I tried to keep them alive?" Bran demanded.

"I don't know. I've been wondering why they don't steal food. They could, easily. What you're saying is that they've lost all self-respect—lost it so totally that they prefer death to further humiliation."

"Right." Bran nodded emphatically and regarded Farrari with interest. "Self-respect. That's it. IPR can't give that to them because there's nothing in the manual about self-respect. If it was a disease they had, the base doctor would concoct a serum and the agents would go around pouring it into the soup pots, and the first thing you'd know we'd have a nice revolution going. But there isn't any medicine that can cure a lack of self-respect."

"And yet—there are *olz* who want to live," Farrari said thoughtfully. "I was with Liano Kurne when the plague started—she was a *yilesc* and I was her *kewl*—and a dying *ol* came to tell us his village needed help. It was raining, and he ran though clay so sticky that I had trouble walking in it and climbed a slope so steep I would



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have had a hard time climbing it in dry weather. He dropped dead. If he was so intent on dying, why would he make that heroic effort to get assistance?"

"I don't know. I never met any *olz* like that. I'd hoped there were some, but I never met any."

"So how do we go about restoring their self-respect?"

"They need a victory over the *rascz*. It wouldn't be hard to arrange one, but the moment word got out that there'd been an uprising, soldiers would come and kill all the *olz* in the neighborhood. Self-respect wouldn't be of much use to them if they died immediately after they got it."

"It wouldn't be an encouraging example for other *olz*, either," Farrari said. "Have you thought of arming them?"

"What good is a weapon without the desire to use it?"

"Or the skill," Farrari suggested. "The *kru's* soldiers probably put in years of practice in throwing spears before they're promoted to the cavalry." He got to his feet, picked up a rock, and threw it toward the entrance. "Self-respect. It's something to think about."

"What are you doing?" Bran demanded.

"I'm going to clear out this passage. I want to see the rest of the murals."

"It'd take machines to move some of those rocks," Bran said.

Farrari heaved another rock toward the entrance. "Is it possible that the *ol* civilization used caves for dwellings?"

"It's possible that you'll bring the rest of the ceiling down on your head," Bran growled. He left muttering to himself, and Farrari labored for hours before he finally gave up. Many of the huge slabs of rock *would* have required a machine to move them, and the rubble obviously extended far back into the cave.

On one side he managed to bare a few more meters of the mural, and he remained there looking at it until darkness fell and Bran returned to caution him about showing a light at night—base's platforms sometimes flew near.

He had uncovered several of the older, massive buildings of Scorv, shown before the time when the city became crowded and the ponderous concepts of its architecture were diluted. Beyond them stood the Tower-of-a-Thousand-Eyes without the *kru's* Life Temple surrounding it, and the *kru's* portrait above its entrance was the portrait of an *ol*.

Farrari ate a belated supper in the blacked-out cave, and Bran, who had already eaten, joined him for a second meal. Farrari asked suddenly, "Isn't there some way the *olz* could achieve a victory over the *rascz* without giving cause for calling out the militia?"

Bran chewed thoughtfully and



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swallowed before he answered. "Anything that mild wouldn't be a victory," he answered gloomily.

"Suppose the *olz* were to ridicule a *durrl*? He wouldn't call out the soldiers because his *olz* were disrespectful. He'd be too embarrassed to admit it."

Bran shook his head. "The *olz* would never be disrespectful to a *durrl*.

"I know two who would."

A look of wild surmise transformed Bran's hideous face, and just as abruptly he became despondent again. "What would it accomplish? He wouldn't call out the soldiers, he'd just whip to death anyone who saw it."

"He'd have to start with us," Farrari said, "and any *durrl* who tries to whip me is going to get a whipping with his own whip. If we don't take some risk, we'll never do anything."

Bran was silent for a long time. "You're right," he said finally. "I've thought and thought about this for years and I've never done anything. We'll go tonight."

"Can we take some food for the *olz*?"

"They don't need food this time of year," Bran said, and added wistfully, "If you want to take food, figure out how to take some IPR rations for us."

"Pack some on the platform," Farrari suggested. "Whenever you're hungry you can sneak away for a meal."

"I'll do that," Bran agreed, immediately more cheerful.

They landed near the village Bran had selected, concealed the platform in a *zrilm* hedge, and joined the *olz* at dawn. If the *olz* found anything remarkable about the sudden increase in their village's population they gave no sign of it. A short time later, divided into small groups, they were hard at work in the fields.

Farrari, accustomed to the tedious, energy-sapping labor, applied his stone-tipped hoe stoically and tried to ignore the sweltering sun. Bran suffered cruelly, and as the day wore on Farrari became increasingly concerned about him. The *olz* would not have understood his affliction because no *ol* lived long enough to become enfeebled by old age, and Bran was an old man. By late afternoon he was reeling alarmingly and showing signs of a high fever. Farrari finally went to his assistance.

"I'll stick it out," Bran muttered.

"You will not. What's the procedure when an *ol* gets sick?"

"There isn't any. He works until he drops, and no one pays any attention to him until the end of the day. Then they carry him back to the village. Dead or alive."

"Then it's time someone created a precedence."

He helped Bran over the stiles. Neither the *olz* in their field nor in the field they had to cross seemed to notice. They gained the lane,



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turned away from the village, and a short distance further on sought refuge in the *zrilm*. Bran was dehydrated and in an agony of thirst, but he insisted that they both remain in hiding until dark. "Can't risk it," he muttered. "Running off like that, we'll be missed if they check the field again."

"Again?" Farrari repeated blankly.

"*Durrl's* assistant looked in this morning."

"He just climbed the stile, looked, and went away. That's as much checking as they're likely to do this time of year, but he may look again on his way back. A *durrl's* assistant is trained to notice things like too few *olz* working a field." He panted for a few minutes and then croaked with parched lips "I'm getting old."

"How frequently does the *durrl* himself come around?" Farrari asked.

"This time of year, maybe not at all. There's no close supervision like at planting time, when the *olz* might eat the seed stock instead of planting it, or at harvest time, when the *olz* might eat in the field instead of waiting to have some of the food they've just harvested rationed out to them."

"How frequently does the *durrl* inspect a village?"

"He doesn't, not unless something unusual happens. Not during the warm months. If so many *olz* got sick that the cultivating was neglected, he might look in to make certain that they weren't shirking."

"*Olz* never shirk," Farrari said.

"No, but the *durrl* looks at it from the point of view of the *rascz*, and if the *rascz* were slaves they'd shirk so he figures the *olz* will shirk if he lets them get away with it. During the winter he'll visit the villages once in a while to check the death rate and try to figure out whether the *olz* can last until spring planting without special rations." He turned slowly. "Now I see what you're driving at. We want to embarrass a *durrl* in front of the *olz* and we can't. When they're at work there are too few of them in one field to matter, it'd be a waste of time to embarrass a *durrl* with less than a whole village looking on, and the only time that could happen is during the winter when the *olz* are too hungry and sick to care whether a *durrl* is embarrassed or not. I'm getting old." He sighed. "I should have thought of that."

"We'll contrive something," Farrari said confidently.

Bran shook his head. "No. It was a silly idea."

"What would happen if an aristocrat walked into a village at dawn and told the *olz* to take the day off?"

"They'd stay in the village. Something like that does happen now and then, usually when the ground is so wet that cultivation



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might damage the crops. It isn't thought of as giving the *olz* a day off, but as letting the fields rest, and no aristocrat would set foot in an *ol* village. I've never heard of one being able to speak *ol*. The *durrl's* assistants would take care of it."

"You dressed as an aristocrat and ordered *olz* about."

Bran shrugged. "The *olz* don't know that an aristocrat isn't supposed to speak *ol*. They don't know one *rasc* from another. They'd obey anyone dressed in any kind of *rasc* costume. I just happen to have some aristocrat robes."

"What would a *durrl* do if one of his *olz* ran up and told him that a strange *rasc* demanded his presence at the village?"

Bran chuckled. "You can't say that in *ol*, but you can say enough to make the *durrl* think someone important wants him. He'd kill his *gril* getting there."

"Would he send an assistant?"

"Not a chance."

"And if he arrived and found no *rasc* but a whole village of loafing *olz*?"

"He'd be incensed," Bran said.

"I hope so, because it's the mood that'll make him the most vulnerable. That's what we'll do—use your aristocrat robes, order the *olz* to let the fields rest, and send one of them for the *durrl*."

"It might work," Bran admitted. "We'll try it tomorrow."

"Tomorrow you're going to rest, and then we'll work out some practical jokes. And then we'll go far enough away so that the village we choose won't have heard about our peculiar conduct today."

Again they reached a village at dawn. The *olz* reacted as Bran had predicted: a few grunted words from a pseudo-aristocrat, which they heard with heads bowed, and they immediately returned to the fire pit. The fire had gone out, but they grouped about the cold ashes just as they crowded about a night-fire. That was, seemingly, the only thing they had to do on a day of leisure.

A young *ol* was chosen, and after a grunted instruction he whirled obediently and ran off. Farrari and Bran left in the opposite direction, cached their costumes with the platform, and returned to the village as *olz*. They took their places by the dead fire and waited.

The *durrl* arrived on a racing, panting *gril* and when he saw no aristocrat, only his *olz* huddled about a nonexistent fire, he leaped from his *gril* in a thunderous rage and began to berate them. The *ol* language was unequal to his anger, and most of what he said was in *Rasczian*.

Farrari edged away, gained a position behind the *durrl*, and began to mimic him. The *durrl* gestured, stamped a foot, waved his arms. Farrari did the same. Bran had made his way to the *gril*, and he



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quickly tied a cord to a front foot and the opposite hind foot. Even if their scenario failed, the *durrl's* departure was certain to be less than dignified.

As the *olz* became aware of what was happening, one after another raised his head in appalling disrespect to stare past the *durrl* at Farrari. Their expressionless faces provided no clue to their thoughts, but the fact that they dared to look seemed promising.

The *durrl* finally became aware that he had less than their complete attention. He pivoted slowly; Farrari pivoted slowly. He turned again; Farrari turned again. That happened twice before the *durrl* understood what was happening. With a bellow of rage he confronted Farrari.

Bran scurried into position behind the *durrl*. Farrari delivered a vigorous push, and the *durrl* went over backward in a tumultuous flutter of robes. He scrambled to his feet bellowing and raced to the *gril* to snatch his *zrilm* whip. Farrari faced him calmly as he raised the branch for a flesh-tearing stroke. Bran was in position again, and he adroitly jerked the *zrilm* from the *durrl's* hand and flung it aside.

The *durrl*, his rage beyond containment, leaped onto his *gril* and kicked at the beast's flanks. The *gril* attempted to leap forward and fell heavily, and the *durrl* pitched over its head and landed with a sickening thud.

Bran quickly removed the chord from the *gril's* legs, and the beast scrambled to its feet and stood trembling. The watching *olz* did not move.

**IN TIMES TO COME** Next month's lead novelette by Stanley Schmidt is "The Unreachable Stars."

At the moment the road to the stars seems to be seriously impeded by the speed of light limitation—but the history of science has been that a full understanding of any law of Nature leads to an understanding of how to make that law work for you instead of against you. Fire was the great threat-enemy of animal life—until Man learned how to use it. Lightning was the thunderbolt punishment of the gods—until Man learned how to channel that power and call it "electricity."

It's seldom that a physical law permanently imposes barriers—it simply requires doing the desired thing in some other way. You can't shout loud enough to send a message across the Atlantic—but we talk across the Atlantic and even across 240,000 miles of airless space (that makes sound-transmission impossible) whenever we wish.

Historically we can predict with high probability that the speed of light limitation is *not* an absolute barrier.

But on the other hand there is a type of barrier that makes it impossible for our human culture to reach the stars. There are already signs of that barrier developing—and as Shakespeare said "The fault, dear Brutus, is not in our stars, but in ourselves, that we are underlings."

And that's what Stanley Schmidt's story develops. THE EDITOR



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Neither did the *durrl.* When Farrari went to him he found him dead, his neck broken.

Farrari beckoned Bran to his side and hissed, "Some joke. What happens now?"

"I don't know," Bran said soberly.

"We can't run off and leave them."

"No. We'll have to stay and see them through."

"Shall we send for the *durrl's* assistants?" Farrari asked.

"I think we'd best let the *olz* handle it now."

The *olz* drew nearer, their eyes on the *durrl.* A woman raised a sobbing cry, another joined her, and another, and their wails became a choked chorus of weird laments. An *ol* wandered off aimlessly and returned with a large rock. He flung it to the ground in the open space near the fire pit. Others brought more rocks. A hut was torn apart and its sticks and chunks of hard clay added to the pile. Finally the *durrl's* body was gently carried there and propped into a sitting position.

"An altar," Farrari muttered.

Bran said nothing.

The *olz* prostrated themselves before the dead *durrl,* lying motionless with their faces in the dust. They remained there, Bran and Farrari with them, while the sun rose high in the sky and the temperature became stiffling. It was nearly midday when one of the *durrl's* assistants came looking for him and found the strange tableau: the *durrl* dead and the entire village performing obeisance to his body.

He jerked an *ol* to his feet and angrily shouted a question. The *ol* grunted an answer: *gril fell, rider fell.* The *gril* still stood nearby, its coat clotted with blood and dust. The assistant examined it, examined the *durrl,* and asked no more questions.

He returned with another assistant and removed the *durrl's* body in a wagon. The *olz* remained prostrate. Night came, but they did not light a fire. They remained there through the night and all of the next day, raising sporadic laments, and when night came again they finally stirred themselves—and moved. They divided up their scant stores and scattered to neighboring villages. Bran and Farrari waited another day, but none of the *olz* returned.

That night they returned to the platform and flew back to Bran's valley.

"So much for their self-respect," Farrari remarked bitterly.

Bran was merely incredulous. "They *worshiped* him!" he blurted.

Farrari nodded. "I knew it wouldn't be simple, but I never expected anything like this. How do you organize a revolt against the gods?"

TO BE CONCLUDED



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# MAY THE BEST MAN WIN



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*There are many ways to measure a man's age—*
*and most are pretty meaningless.*
*There's only one important measure of a man.*

STANLEY SCHMIDT

*Illustrated by Leo Summers*

Matthew Kilroy's name was just a lucky coincidence, but the crowd down on the floor of the convention hall remembered the ancient phrase and was taking full advantage of it. Pete Haldrickson watched them on the monitor in Kilroy's suite upstairs and wondered desperately how to make Matt see that they were right. They carried huge placards of Matt's tanned, deeply lined face with the slogan "Kilroy is here!", and though the monitor's sound was turned low Pete could hear them chanting it over and over. There was something down there that he had not seen at a party convention in the last four Presidentials—an ebullience, a genuine sense of impending victory—and Pete didn't want to lose it. Not when they were this close.

He turned to Matt's real face, even more engraved by experience than the one on the placards and surrounded by thick shocks of graying hair. "Matt," he said earnestly, "listen to them. They want you. You can't let them down."

Matt shook his head. "I'm sorry, Pete. I'd like to do it, very much, but I can't. I've said that ever since I got back, but they won't listen. I've been out of touch far, far too long . . ."

"You can catch up fast. You're a bright boy, Matt."

". . . And I'm too young."

Pete let his breath out in an exasperated *whoosh*. "Come on, Matt, don't start *that* again!" He opened his attaché case, withdrew a document and waved it in front of Matt's face. "A photostat of your birth certificate," he reminded. "Denver, May 9, 2026. You're fifty plus, and the Constitution only requires thirty-five. What more could you ask?"

"We can't think that way any more, Pete," Matt said quietly. "Not with relativistic starflights



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here for real. I want them to continue as much as you do, and I agree that my election might help. But we have to face the new realities that come with them, even if it means legal complications. Time dilation is real, Pete. I'm only thirty-four, and I'll still be thirty-four at inauguration time. I can't run for President."

"You don't look thirty-four," Pete snapped. He walked across the room and poured himself a drink.

"I *could* look a young fifty," Matt granted. "Or an old thirty-four. Believe me, it's an old thirty-four. It wasn't an easy trip, Pete. It took a lot out of me." He waited for Pete to say something, but Pete didn't. He just toyed with his drink, waiting for Matt to get this out of his system. Matt finished, "You've heard the saying that a man is only as old as he feels. Well, that's going to have a new meaning from now on, and it can't be ignored."

Pete sipped nervously at his drink, trying to think of a new approach. Here was a man who was the party's great hope for revival—a man so idolized by the public that, if nominated, he would virtually guarantee victory at the polls. And a man with clear-cut legal qualifications so well documented that they couldn't possibly be challenged.

And yet, maddeningly, a man who was himself challenging those qualifications on the basis of some academic silliness. A man who had the Presidency within his grasp—within Pete's party's grasp—and was quite prepared to throw it away.

Pete finished his drink and looked at Matt. He didn't really have anything new to say, but he had been silent too long and time was short. "Look, Matt," he began, "you're being stubborn. Look at it this way. What difference does it make whether you *call* it thirty-four or fifty? By *our* records you're fifty, no buts about it, and that's what—"

He broke off, distracted by a thunder of applause from the TV monitor. He glanced at the screen and saw a familiar figure mounting the podium. *"Sh-h-h,"* he whispered, his own speech temporarily forgotten. "Ralston's starting your nomination speech."

"But I don't want—" Matt began. Then Pete glanced sharply at him and he stopped and watched the monitor.

The crowd had quieted. ". . . A man who needs no introduction," Ralston was chanting. "A man just back from the stars, with word of man's first successful colony beyond this Solar System. A man who personally led the founding of that colony, in the face of great hardships he never expected to be his. A man who joined the Epsilon Eridani expedition as third mate at the tender age of twenty-five—and



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who led it single-handedly to its destination after the tragic death of his commanding officers in an accident in space. A man who lost his own dear wife to the perils of an alien wilderness—but then stayed on to see the colony through its first precarious months. And a man who has made the long voyage home with a skeleton crew to bring us the good news—that the wide open spaces are there and mankind's baby is alive and kicking. I give you . . . *Matt Kilroy!*"

His voice rose shrilly on the last words, just in time to be heard over the tumult of cheers and stomping of feet from the floor. Pete caught the contagious excitement and succumbed to a wave of deep emotion. Out of the corner of his eye he saw Matt squirming uncomfortably in his chair, but paid that little heed. He settled back to listen with ever-growing excitement as the chairman began the roll-call vote and state after state announced, "Kilroy!" At this rate he would get it on the first ballot . . .

*They don't understand,* Matt Kilroy thought, still half incredulous. *They just don't understand. They actually think time dilation something that only exists in physics books. They can't grasp that it's the real world the physicists are talking about.*

His appearance didn't help, he realized. The harshness of the trip and the frontier, and the work he had put into them, made it at least as easy to believe he was fifty as thirty-four—made it easy for Pete to ask, "What difference does it make?" And he was the only example they had ever seen.

But he knew. And they were going to have to learn.

He listened to the states' delegates flamboyantly casting their votes, mostly for him. He had to struggle to fully realize *this* was happening. The possibility of hero worship being carried to such a pitch on his return had never even entered his mind—until he landed.

Now they were voting. And he was winning, and Pete Haldrickson wouldn't listen to reason. There wasn't much time left to put an end to it.

"Louisiana . . ."

He had to make them *realize* it wasn't purely academic.

"Maine . . ."

There was a way, he knew. He didn't like it, but maybe it was the only thing that would work.

Cindy.

The public had forgotten her, it seemed, or assumed that she had died with Marta. That was O.K. with Matt—he had been content to keep her out of the public eye. He hated to think what publicity—by journalists who thought they were cute—could do to her.

But maybe he could keep it private. Pete was an old friend from before the expedition. Maybe if Matt made just *him* realize, *he*



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could take it from there and keep Cindy out of it.

Matt hoped so, anyway.

"Maryland . . ."

"Pete," Matt said suddenly, "I don't believe you've met my daughter, have you?"

Pete glanced at him with a frown, mildly annoyed at the distraction, then back at the monitor where things were going so well. "Eh?" he said absently. "I don't think so. What's that got to do with the price of eggs?" A moment later what Matt had said sank in and Pete thought, confused, *Daughter? What daughter?*

Matt went to a closed door across the room, opened it slightly, and called, "Cindy, will you come here a minute?"

Light footsteps came from beyond the door and Pete glanced that way just in time to see a small girl of about nine, with pigtails and freckles, come in and look up at Matt. "Yes, Daddy?" she said.

"I want you to meet Mr. Haldrickson," Matt said. "Pete, this is my daughter Cindy."

"Hi," Pete grunted, trying to concentrate on the voting. "Can't this wait, Matt? Don't you even care what's going on downstairs?"

"I thought," Matt said offhandedly, "that, if I'm going to run for President, I'd let Cindy be my campaign manager."

Something started to sink in. Pete spun away from the monitor and snapped, "Don't be ridiculous, Matt. She's just a —"

"She's twenty-five," Matt said stoutly, "and as much a citizen as you because she was born in Texas shortly before we left." Cindy looked questioningly up at Matt and he patted her on the head. "Mr. Haldrickson's a little confused about ages," he explained.

The initial shock hit hard and passed quickly. Pete nodded dazedly, staring at the twenty-five-year-old little girl. He remembered, now, that the Kilroys had taken a baby girl with them to Epsilon Eridani. Quite abruptly, and quite forcefully, he realized what Matt had been driving at. A birth certificate wasn't good enough any more. What would it have to be, he wondered—a recording clock built into everyone's body at birth? No. Or—

The legal complications were staggering. Pete's head swam as he tried to visualize them.

And then, abruptly, it cleared and he was filled with a new determination. He would win this thing yet.

*"Ohio,"* said the chairman.

"Matt," Pete asked quietly, more serious than he had ever been in his life, "do you really believe that, even if we measure your age your way, those few months should keep you from being President?"

Matt sensed that Pete was going to be difficult. "You'd better go, Cindy," he said. He closed the door



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after her and turned back to Pete. "You saw her," he said. "You consider her a qualified voter?"

"I don't know," Pete said evenly. "I asked you a question."

*"Oregon . . ."*

"What I think doesn't matter," Matt said. "The law's written with an age requirement—for the Presidency and a thousand other things."

"The law doesn't say a thing about Einsteinian formulas, Matt. I'm going to say it again, and I want you to listen close. The way the law's written now, your birth certificate proves your age beyond a shadow of a doubt. There's nothing to stop you from being President."

"And there's nothing to stop Cindy from voting for me! Pete, I'm trying to make you realize—the law will have to be changed. It'll have to recognize that when people ride starships, ship's time is what counts."

*"Pennsylvania . . ."*

"I won't argue with that," Pete said stubbornly. "But the old laws are the ones we have now. O.K., they'll have to change. But are you sure that's the way to change them? Just keep the old age requirements and write in some big ugly formula to figure out what a man's age is?"

Matt frowned. "What are you getting at, Pete?"

"Do you honestly believe a man's age—by *any* clock—is that good a measure of his competence? What we need in a President is not chronology and years—it's leadership. Do you honestly believe that you—with your thirty-four self-measured years of leading people through crisis after crisis and coming out on top—do you believe you're less fit to be President than those other guys with their fifty years of fund-raising dinners and smoke-filled rooms? You *can't* believe that, Matt! And you can't expect me to believe it.

"Look—the law's going to have to get more complicated on this age business, right? So why not take the chance to recognize that maybe the way to complicate it is to scrap the age criterion altogether—anyway for something as important as the Presidency. Give them an incentive to find another yardstick that means more—*after* the election. Because you, Matt, are without a doubt the best Presidential material this country's seen in twenty years. We need you—and under the *present* law your excuse won't hold up."

*"West Virginia . . ."*

"In principle," Matt admitted, "I agree with you. But—"

"No buts!" Pete interrupted sharply. "May the best man win—no matter how old he thinks he is. And then *after* the election let them find out about Cindy. She can make them then see the law needs changing; you can make them think twice about how they change



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it. You can help shape the change. Please, Matt—"

The last delegate's voice was drowned in a tremendous roar from the crowd. Pete and Matt turned toward the screen, toward the sea of cheering people and waving placards. Holding his breath, Pete watched Matt's face as the roar resolved itself into rhythmic applause and a swelling chant of *"We want Kilroy!"*

Then, slowly, the expression on Matt's face changed, and in a minute all hesitation had drained from it. He stood up.

And Pete watched with enormous relief as the next President started downstairs to answer them. ■

**THE ANALYTICAL LABORATORY** Every so often I hear from readers who have joined the ranks since the An Lab operation system was last explained.

Readers' letters and post cards come in and votes on the stories are scored on a tally sheet. When we are about to make up a new issue the votes are counted, added up, and the score determined.

Each reader votes stories into First, Second, Third, et cetera, place. Each vote for the First place nets that story a "1" on the tally; Second place is "2"; Fifth place gets a "5".

Obviously, as in golf, a low score wins the game. We add up the tally on each story, then divide by the number of votes cast to determine the "point-score"—the average vote figure for that story. The one with the lowest point-score wins First place. The highest point-score is the outsider in that month's vote.

Next we make out a check—the money kind—for the author of the #1 winner, pay him an additional one cent a word for a total of four cents a word on his winner. The Second place author gets a half cent a word bonus. For a serial that wins First place, this can mean the readers thank the author for a good job of entertaining, and satisfying him with something like an additional $750.00—which is highly satisfactory to any author. It's not only ego-boo for winning—it's hard cash.

If an author's done a good job of entertaining you, you can help thank him with a post card that can "put your money where your mouth is" with cash. And if you definitely dislike some yarn, you can express that Bronx cheer feeling equally realistically.

The resultant point-score figures and place standings are then published in the Analytical Laboratory. This month's results worked out thusly:

**DECEMBER 1970**

| PLACE | TITLE | AUTHOR | POINTS |
|---|---|---|---|
| 1. | The Tactics of Mistake (Pt. 3) | *Gordon R. Dickson* | 1.73 |
| 2. | Big Time Operator | *Jack Wodhams* | 2.52 |
| 3. | Ecological Niche | *Robert Chilson* | 3.15 |
| 4. | Apron Chains | *Christopher Anvil* | 3.63 |
| 5. | Forever Enemy | *Howard L. Myers* | 3.89 |



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# the reference library

*P. Schuyler Miller*

## CONS TO COME

The general policy of this department is to devote space only to those fan activities of broad interest, such as bibliographical work and the World Science Fiction Conventions. This is partly the magazine's policy and partly my own: I can't keep up with current science fiction, let alone the torrent of excellent fanzines that exist, and a few of which I see.

Thanks to a couple of these publications, I was able to give you a rundown on the "Hugo" awards made at the 1970 Worldcon in Heidelberg, Germany. Now I have a bulletin from the committee in charge of the 1971 Con, the Noreascon, to be held in Boston on the coming Labor Day weekend, September 3-6. I will follow that with some other news of coming conventions, cribbed from the October issue of *Luna*, a monthly fanzine published by Frank and Ann Dietz of 655 Orchard Street, Oradell, New Jersey 07649. *Luna* costs 30¢ a copy or $3.50 a year ($4.25 if you want it by First Class mail). I suggest you try to get the October issue, for it has a concise report of the business of the Heicon, plus news of many future conventions throughout the world. There are also listings of current and forthcoming SF books and magazines, and reviews that are a good deal more timely than mine.

End of that commercial. Now for the Noreascon. The place will be the Sheraton-Boston Hotel. Guest of honor and banquet speaker is Clifford Simak, imported from Minneapolis. Bob Silverberg will take over the MC's spot and bridesmaid Isaac Asimov will hand over the awards.

Harry Warner, the historian of American science fiction fandom, will be fan guest of honor—and that's overdue, too. There will be the usual features. The masquerade may even get itself banned, though I understand Boston has changed.

To vote on the Hugo awards for best science fiction—and to help pay for them—you have to be a member of the Noreascon. This will cost a little more than usual. If you join before August 10th—after



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which it will be too late to vote, anyway—it costs $6.00. The price is $4.00 if you can't attend, but do want their announcements, program booklet, and a "Hugo" vote. If you wait to register at the convention, it will cost more. Make checks payable to "Noreascon," and send them to Post Office Box 547, Cambridge, Massachusetts 02139. Don't forget to supply your name, address and zip code. Convention committees, year after year, get money from people who assume they are famous enough so that they can dispense with such trivia.

*Luna* has a solid page of regional conventions that will be held long before you see this, early in 1971, and another page that will come later. If you want details, get the magazine. Some, though, are becoming traditional. Los Angeles is taking advantage of the new three-day weekends to launch a Presidents' Day Conference on February 12-15. The sixth Marcon comes March 26-28 in Columbus, Ohio. (I'm told this is becoming a big success.) English pros and fans will hold their *twenty-second* Eastercon in Worcester, next April 9-11, and Illinois fandom are meeting the same weekend for Pecon 2. (This sounds like Peoria, but the chairman is in Champaign; keep in touch with *Luna*.) The New York annual, Lunacon, comes the following weekend, April 16-18. The Midwescon, the con without a program, will rise up in Cincinnati, Ohio some time in May—no data yet—and Dallas will convene July 8-11—trust Texas to stretch the 4th of July holiday into something comfortable.

Conventions are now a worldwide phenomenon. Japan was host to the first International Science Fiction Symposium the week after the Heicon, with Japanese, American, English and Russian professionals attending. Twenty-odd countries were represented at the Heicon, and Europeans have agreed to launch a series of annual conventions with one at the 1972 Trieste SF Film Festival. Europe hopes to have an award of their own—pan-European—plus national citations. East Germany had its Fifth Conference on Utopian Literature in June, according to *Luna*. Sweden will be a contender for the 1976 Worldcon. (Have I said that Los Angeles will host the Thirtieth Worldcon in 1972, and Dallas is working hard to get the 1973 bid but will have competition from Minneapolis?) Maybe Demark will try to sell a Pornocon.

Why go to a convention? They have good programs, and I'm told that more and more people actually attend and participate. They have wall-to-wall and dusk-to-dawn socialization—partying, lest I sound Marxist and upset someone. They have professionals, editors, artists, and fans of all ages who have the same interests you do.



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There are nuts, certainly, but you were a nut once . . . and the old nuts of your generation are there, too. "Doc" E.E. Smith rarely missed one, and was as well loved for himself as for his "Lensman" stories—and still is. Find a con your size, local or regional, and stick with it. If you don't like it, don't go back. If you do, try one of the big ones. Even England. Even Trieste.

## THE ATLAS OF THE UNIVERSE

*By Patrick Moore • Foreword by Prof. Sir Bernard Lovell • Rand McNally & Co., New York • Printed in the Netherlands • Sneets N.V. Weert • 267 pps. + Index • 11" x 14" • $35.00*

"The Atlas of the Universe" is a truly large-scale title—but this one earns it. It also earns the trite old comment "Must be seen to be appreciated." See it at your local library to start with—and light a fire under the librarian till he gets it as a necessary reference text!

The Atlas covers the Earth's geography, geology and meteorology as seen from the space capsules, with magnificent large-size (11 x 14 inch) color photographs supplied by NASA.

The Moon is covered in equal detail with Russian and US photographs—everything from the Luna soft-lander through Ranger, Surveyor, Orbiter and Apollo shots. There are complete large-scale maps of both sides, also.

The Solar system is shown in detail, with complete available information; Mars, naturally, being shown in Mariner shots from NASA.

Going outward, there are color plates on the stars, with data on present knowledge of stellar evolution, then the local galaxy, the evolution of galaxies, the remote galaxies and present knowledge of cosmology.

There are maps of the galaxy as seen optically, and as "seen" by radio telescopes.

This one, in other words, honestly earns the title "Atlas of the Universe."

As a reference book, it is, so far as I know, unique—and fills a real need. Every library that claims to have a reference section must have this.

The $35 price is not puny—but this is definitely a bargain at that price. If you're in a position to add this to your own library—do. If you can't yourself afford it yet—well, it's too bad it came out too late for Christmas, but there are always birthdays and, if need be, next Christmas! JWC

## DIMENSION X

*Compiled by Damon Knight • Simon and Schuster • New York • 1970 • 351 pp. • $5.95.*

It is gradually seeping into my thick head that we are starting a whole new cycle of anthologizing.



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The great old ones that had all the classics have gone out of print—even in paperback—and the copies in libraries have been read to shreds. So it's perfectly reasonable to put old wine into new bottles for the libraries and for all the new readers who have never heard of, let alone read, the good old stories which are better than many new ones.

That's what Damon Knight has done in this book. He has assembled five top-quality "novellas"—one pretty short for that classification—by one sometime and four major writers: Robert A. Heinlein's great "Man Who Sold the Moon;" C. M. Kornbluth's "The Marching Morons" (the short one); Richard McKenna's "Fiddler's Green" (not his best, to my taste); Brian Aldiss' award-winning "The Saliva Tree," and Isaac Asimov's too-little-known "The Ugly Little Boy."

If you haven't read these stories before, now's the time. If you know them by heart, talk your local library into getting the book for both its adult and its teen-age departments.

**I WILL FEAR NO EVIL**

*By Robert A. Heinlein • G. P. Putnam's Sons, New York • 1970 • 401 pp. • $6.95.*

The new Heinlein novel has to be the greatest disappointment of the last five years. I may only be showing my age and squareness in saying so. A publisher's flier says that Heinlein considers the book "in a direct line of development from 'Stranger in a Strange Land'," the book which has supposedly been adopted by the young as their guide and touchstone. (Putnam says it has sold a *billion* copies!). This new novel may take them the next step of the way, since it extols the magics of sex and yoga. It leaves me shuddering in 1920 . . . or maybe 1880.

If you read the serial in *Galaxy*, you are supposed to have read the complete book: I didn't read the serial and I haven't compared them. How *Galaxy*'s editor found enough suspense to sustain interest, I suppose I won't know unless I do.

The trouble is that Heinlein does none of the things he can do better than anyone else. He postulates a grisly projection of our present society . . . and lets it lie there. He shows us a future in which the taxpayers have decided to quit paying for schools, police protection and such socialistic nonsense, though there is either a total welfare system to keep people alive or some form of work-for-pay economy (one minor character sells paintings; lawyers make a living; the well-to-do have armed guards—and have to have them, or they'd be mugged instanter). Since the story deals almost entirely with Billionaires' Row, the world rarely intrudes. When it does, it is, of course, fleshed out in true Heinlein manner.



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But the story in which these rare nuggets are concealed is simply one interminable and increasingly tedious gag. The world's richest man, too rich to die but bedridden and moribund, decides to have his brain transplanted into a young body. The body, through a screaming coincidence, turns out to be that of his beautiful young secretary—and for reasons that are never really rationalized but could have been, her *persona* also inhabits her "dead" body.

Once upon a time Heinlein would have done wonders with this. Now, for presumably philosophical reasons best known to himself, the remaining hundreds of pages are given over to a kind of nightclub repartee between Johann Sebastian Bach Schmidt/Smith, raunchy nonagenarian male, and Mrs. Eunice Branca, young, modern, sexually liberated (could one say nymphomanic?) female. After some preliminaries in which old Johann learns how to "be" a woman, the two spend most of their time bantering about what kind of sexual permutations to carry out with whom. (It seems that the young of the time recognize six sexes.)

Formal plot considerations do intrude a bit from time to time. There is some potentially nice fencing in a legal hearing, when Johann's granddaughters are trying to have him declared incompetent, or dead, or some combination of the two. There is some byplay with Eunice's artist husband. A little yardage is gained over the fact that Eunice has been the mistress of old Johann's attorney . . . that his ex-nurse is shacked up with his physician. At one point they decide it would be cute for Johann (now Joan—pronounced Jo-anne) to be both father and mother of a new heir. (Remember "All You Zombies"? It's simpler the new way.) Eventually the psychic twosome becomes a threesome—with no rationalization this time—and they all head for the Moon.

I dunno whether John Campbell had a whack at this and decided not to buy it, but if so, he showed good judgment. Do you suppose the Heinlein name will automatically get the book a "Hugo" as best SF novel of 1970? Or is it just that I never got out of the Munsey era?

**THE SCIENCE FICTION HALL OF FAME, VOLUME ONE**

*Edited by Robert Silverberg • Doubleday & Co., Garden City, N. Y. • 1970 • 558 pp. • $7.95.*

The twenty-six stories in this anthology were selected by members of the Science Fiction Writers of America as the best of all time, prior to the inauguration of the SFWA "Nebula" awards in 1965. The book was intended to be a sort of retroactive Nebula selection, and there will be more to come. Any story longer than 15,000 words was automatically excluded, and



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will be considered for a future volume or volumes.

SFWA members, Editor Silverberg tells us, nominated one hundred thirty-two stories and were asked to vote for ten. The natural spread in the resulting vote produced a stand-out list of fifteen—plus five ties—and Silverberg used his own judgment beyond that point, though sticking within the rules.

These rules are about the only drawback to the book. I've mentioned the length restriction—and I sincerely hope it explains why we have Theodore Sturgeon's "Microcosmic God" instead of "Baby Is Three." Authors were limited to one story each.

I don't think good early science fiction is adequately represented—there are only three stories published before 1940—but the book was deliberately planned as a definitive anthology of *modern* SF. Stanley Weinbaum's "A Martian Odyssey," John Campbell's "Twilight," and Lester del Rey's "Helen O'Loy" are certainly as modern as anything published today.

My judgment doesn't always match the judgment of my peers. I can't see choosing Bradbury's "Mars Is Heaven" over "There Will Come Soft Rains." I'd have picked Van Vogt's "Black Destroyer" over "The Weapon Shop," and I'd have preferred a couple of Cordwainer Smith's other stories to "Scanners Live in Vain," which was his first. But no anthology that contains Tom Godwin's "The Cold Equations," Alfred Bester's "Fondly Fahrenheit," Daniel Keyes original short version of "Flowers for Algernon," and Roger Zelazny's "A Rose for Ecclesiastes" can be all bad.

We don't have room to list all the twenty-six stories in the satisfyingly fat book, let alone comment on them. But, in line with the short-story ballot I announced here recently, which we will conduct with the help of the Washington Science Fiction Association, you may be interested in the favorites. I am cribbing from the introduction, which carries the list to fifteen:

1. "Nightfall," by Isaac Asimov;
2. "A Martian Odyssey," by Stanley G. Weinbaum;
3. "Flowers for Algernon," by Daniel Keyes;
4 & 5. "Microcosmic God," by Theodore Sturgeon—tied with "First Contact," by Murray Leinster;
6. "A Rose for Ecclesiastes," by Roger Zelazny;
7-10. "The Roads Must Roll," by Robert A. Heinlein—tied with "Mimsy Were the Borogroves," by Lewis Padgett, "Coming Attraction," by Fritz Leiber, and "The Cold Equations," by Tom Godwin.

Do you agree that these are the ten best science-fiction stories of all time . . . or of modern times?



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# brass tacks

Dear Mr. Campbell:

Nowadays, nuclear systems either match, or better, the costs of coal-fired power stations or utilities won't buy them. Walterscheid gave some vague hints that nuclear costs are cheaper than coal's but avoided any firm figures. Of course, the big backlog of orders for nuclear stations must mean they are cheaper to operate than coal-fired ones. Doesn't it?

Walterscheid casually accepts the US-designed light-water reactor (LWR) as the best system under most circumstances. Yet, without US Government enrichment services at bargain rates, the virtues of the LWR are not that overwhelming. Who wouldn't want a compact reactor when he's faced with fabricating a pot from 12- to 18-inch thick steel plate? To diameters as large as 50 feet? Make the pot much bigger and fabrication becomes a nightmare.

Also, light or ordinary water is a poor moderator; it gobbles up neutrons. Graphite is at least 10 times more efficient; heavy water $10^5$ times better. Which is why a heavy-water reactor (HWR) can burn natural uranium, 0.71% U-235, until the fissile content is 0.2-0.3% U-235, whereas a LWR must start with 2-4% U-235 and be refueled when the fissile content reaches 0.9-1.0% U-235.

A power system is compared on its capital costs, its fueling costs, other operation costs, all of which combine into a unit power cost, and on the station's service life—which of course affects the unit cost.

Currently, coal has these costs: Capital, $90-110/kilowatt of electrical capacity; fueling cost, 0.4-0.5



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cents/kilowatt-hour (assuming coal costs $9/ton); and a service life of 20 years. These factors combine into a unit cost of 5½-6 mills ($10^{-1}$ cents) per kilowatt-hour. Incidentally, power engineers refer to a megawatt as a *thousand* kilowatts for obvious reasons. The costs of a coal-fired steam system will surely rise with time, since the system is mature and is not capable of scale-up into efficient 1,000-megawatt units.

Costs for nuclear systems are not firmly established but order of magnitude figures could be: $200-250/kilowatt of electrical capacity; fueling costs, 0.6-2 mills/kwh; and a service life of between 20 and 30 years. Which results in these unit power costs: LWR (1,000-Mwe), 4½ mills/kwh; AGR (Britain, 600-Mwe), 4½-5 mills/kwh; and HWR (Canada, 750-Mwe), 4 mills/kwh.

As a Canadian, I'm glad Walterscheid mentioned our CANDU reactor—most US writers ignore it, or more quickly dismiss it. Canada operated the world's first HWR in 1945, and has since added three research HWRs and two power prototypes (20-Mwe, 200-Mwe), all for a development budget of less than $1 billion. Ontario Hydro is completing a 2,000-Mwe station (4 x 500-Mwe units) near Toronto and has launched construction of a 3,000-Mwe station (4 x 750-Mwe). Next year Hydro Quebec will start up a 250-Mwe prototype near Montreal—it will raise light-water steam (16% quality) within its vertical pressure tubes. And one of the research reactors (Whiteshell, near Winnipeg) is terphenyl cooled and is being used as a materials testing reactor—one of the items under test is uranium silicide ($U_3Si$) fuel, much denser than standard $UO_2$ fuel.

Walterscheid failed to mention the Carnot principle, the chief reason why the US is researching high-temperature gas-cooled reactors and the light metal fast breeder. Simply stated, the Carnot principle defines the maximum efficiency of a heat engine as being fully determined by the input and exit temperatures of the working fluid. With the exit temperature at 100 F, more or less, the steam turbine's efficiency will depend on the input temperature. Existing reactors can raise steam at 500-600 F. These conditions mean that current nuclear stations can achieve an overall thermal efficiency of 30%, plus or minus 2-3%.

Nuclear superheat now is limited by materials and control techniques—fuel meltdown can easily occur, and high-temperature steam is quite corrosive in a high radiation field—as in the reactor core. Italy is trying steam fog-cooling in a HWR, Canada is researching terphenyl cooling, and US, UK, Germany are trying helium-cooling and sodium cooling, all as efforts to get the steam input temperature up



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to 1,000 F or more. When this is achieved, thermal efficiency will hit 40-45%, and fueling costs will be correspondingly lowered.

One last point: the breeder reactor will not automatically displace other reactor types; it will probably need plutonium from converters for start-up. And the CANDU reactor is a first-class converter (near-breeder) with great fuel flexibility (uranium, thorium, plutonium). Since the LWR needs fuel enrichment and reprocessing, as will the breeder, and since these facilities already exist, then there seems to be a logical place in a utility's plans for a HWR that can burn reprocessed uranium without enrichment. Thataway, there will be three nuclear fuel end-uses by which costs can be balanced out, and enrichment and reprocessing costs stabilized.

THOMAS E. BUCK

241 Armour Blvd.,
Downsview, Ont., Canada

*Why the heavy water approach to nuclear power has been neglected in other countries, with Canada's success known, I do not know. Anyone got data on that question?*

Dear John,

Knowing your continuing interest in psionics and its application I thought you would be pleased to know that the U.S. Army has finally recognized in writing what every field commander has known since snipers carried stones. To be precise: the existence of a sixth sense variously called, combat sense, being battle-wise and several similar things.

I quote from "Field Manual 21-75 Combat Training of the Individual Soldier and Patrolling," Change 1 dated 16 January 1970, Paragraph 232, subparagraph 4: "The sixth sense is an indicator which cannot be attributed to any of the other five physical senses."

The manual goes on to cite the case of a Vietnamese relief column to Pleime in October of 1965. At that time, for unknown reasons, the American advisor changed the unit's route of march and avoided being ambushed by a battalion size unit. Later he could offer no explanation beyond "it just didn't feel right."

The manual then characterized the sixth sense as a "feeling or premonition."

Later the same manual, in the section concerning tracking and trailing, states that a good tracker *"must develop a sixth sense."* It further states "He may often be led to suspect an area because 'it doesn't look right'. This ability often enables a tracker to regain a lost trail or discover new or additional indicators (of enemy activity)."

It's nice to see it enshrined in official print.

TOM ADAMS

19th Special Forces

*The problem is—how do you train that sixth sense??*



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**EDITORIAL**

*continued from page 7*

change his statement even though the majority consensus wants things otherwise.

The liberal/humanist, therefore, has a deep-seated resentment of technology, and resents seeing great effort expended in support of a technical program, while there is so much human suffering that needs immediate attention.

The liberal/humanist tends to be very short-sighted, because he is acutely aware of the immediate discomfort and misery of the poor and the ghetto people—and unwilling to recognize that their only real hope is in technology. That he doesn't accept because he hates the cold, arrogant ruthlessness of Universe facts, and because technology, of course, has no immediate answers to the problems. Money spent on the poor is an immediate answer—as morphine is an immediate answer to the pain of a broken leg. A man with a broken bone doesn't want his pain increased by having someone ruthlessly grab the leg and yank and twist at it—he wants a dose of morphine and to be left alone.

The fact that having that leg yanked and twisted till the bone is properly set is what he *needs* is a Universe fact; morphine and peace is what he feels he needs, and that is a Type Two fact.

The only hope for the poor in the long run is a higher level of technology—the ultimate hope for the ghetto crowding is that men will, in the not impossibly remote future, be able to reach and settle other planets.

But the liberal/humanists will inevitably oppose expenditures of effort in that long-range direction.

In the early Nineteenth Century, it was clear that the West Coast area owned by the United States could never be states; the time needed for a senator or congressman to make the arduous journey clear across the continent would obviously make it impossible for him to get from Portland to Washington after his election, meet with Congress, and get back to his home district in time for the next election. He simply couldn't be in touch with what his electorate wanted.

Suggesting that in considerably less than a century the travel time would be reduced to fewer hours than the months then required would have been sheer nonsensical fantasy.

Right now, reaching other solar systems seems physically impossible, too.

Since my grandchildren are already living, I won't say "My grandchildren will see it!" with any assurance—but, if you're one of our younger readers, I'm fairly confident yours will!

*Provided we push on with manned space operations.*



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The scientists who want to control the instrumented probes from Earth are the laboratory types, of course, the theoreticians, and they aren't happy about the results of manned exploration of the Moon, because there have been too many unexplained facts, and unanswerable questions raised.

The Rangers, Orbiters and Surveyors didn't do that; they sent back more and more detailed answers to the questions they had been sent to solve. They made the observations planned, and reported the data expected.

They yielded good, clean, usable data concerning points the scientists wanted information on. But since the data brought back by the manned expeditions, there has been nothing but a mass of confusion as to Lunar structure, age, and history. The first surface rocks scooped up by the astronauts loused up some of their finest theories by being as old, or older than, the oldest rocks discovered on Earth. The seismograph the astronauts planted reported that the Moon had some weird structure that rang like a doorbell chime when struck—and the speed of sound in the Lunar body appears to be so slow that it doesn't match any Earth rocks. But it does seem to match the speed of sound in various kinds of cheese. Say a large, ripe Edam cheese . . .

Those engineer-astronauts brought back enough data to devastate existent theories, but not the right kind to settle any major question satisfactorily. Now if some real scientists had just been given the chance to look into . . .

Or, possibly, shy off from observing something that must be meaningless because it doesn't fit "known facts"?

The essential point to remember is that any instrumented probe will report *only what it was designed to report*. If we landed an instrumented probe on Mars, and a Martian popped out of his burrow, walked over to the thing, looked at it, spit on it, kicked it and returned to his comfortable underground home—the probe would report a series of Marsquakes of increasing severity, with a severe terminal shock, a minor meteorite impact, and a decreasing series of aftershocks.

After all, it was designed to report seismic events and meteorite impacts, wasn't it?

The Russian soft-lander that picked up a sample of the Moon and returned did bring back a sample. A small sample, taken by pure chance and without conscious selection of material, from beneath the device. It's a valid, and valuable achievement. But the samples the astronauts brought back were consciously selected to be informative, representative, and varied in nature.

The Russian probe *had* to drill in the immediate area that had



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been flooded by the exhaust gases of the soft-lander rocket engines. Porous material that has been outgased by the baking heat of two-week-long days has a fantastic ability to soak up any gas that reaches it—and in a vacuum, gases expand to enormous volume in milliseconds. Particularly hot rocket gases.

Unless the instrumented probe is equipped for diamond-drill type operations, it can't penetrate hard, dense, nonporous rock to get samples that haven't been washed by gas—it'll have to be content to drill into loose dirt.

The Russian triumph with their Moon-drill was shortly followed by an even greater technical achievement—the Moon-crawler.

This device *could* pick up samples at a distance from its soft-lander; the up-coming super-rocket Russia is in process of perfecting could readily lift another Ludhonik Moon-crawler to the Moon, soft-land it, wait for it to range around and collect samples, return them to the landing vehicle, load them aboard, and return those samples to Earth.

The whole process could be controlled by scientists on Earth—just the sort of program Dr. Van Allen and many other scientists want to see carried out. With genuine certified and diplomaed PhD *scientists* "doing the driving" all the way.

Well, it seems there is a slight difficulty, known as "feedback lag." At M.I.T. a couple years ago I watched a graduate student in the computer lab working on a simulated remote-controlled Moon manipulator. There was a 20″ TV picture of what was going on—generated by the computer— on the theoretical Moon, while he controlled a crane with a gripping device. The problem was to lower the crane to grip an ingot which was at the bottom of a small pit, pick it up, carry it across, and deposit it in a collection bucket. The computer was thoughtfully putting in a time-lag approximating that for the round-trip signals from Earth to Moon and back.

Beginners on the job suffered an acute case of stuttering frustration; their commands were ignored for three seconds, seemingly, then acted on inappropriately, and the wrong action continued for three seconds after they ordered it to stop. (One and a half seconds for the cease-and-desist order to reach the Moon, and another one and a half for the "I have stopped," report to get back to Earth. But the student I was watching was already an experienced hand; he had excellent judgment, good reflexes, and a full understanding of the problem. He was doing a terrible job of loading the collection bucket however. The crane would miss its target slightly, and knock the ingot over before he could send the correction signal. The picture on the cathode-ray screen then vanished, to be replaced by "You goofed! Er-



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ror #14"—or whatever the number applicable to that particular mistake might be.

The Russian Moon-crawler is capable of a pretty fair speed; it was operated at the pace of an arthritic and over-age snail—with a degree of caution appropriate to that "feedback lag." That's how the Russians were able to keep it operating, and not burying it in a crater, or stranding it halfway across a boulder with all its wheels off ground.

And it was doing very little if any manipulating—it was strictly a case of "you can look, but mustn't touch!"

It was, beyond any argument, a truly great technical achievement; it's really an unkind cut of Fate that their previous try to bring back a Moon sample just before Apollo 11 failed.

The Moon-crawler was a much greater achievement in many ways.

But be honest in evaluating it; it does *not* approach the capabilities of a trained human being.

The feedback lag from Earth to Moon is something we could struggle with—but the step to the planets is something else again. The feedback lag to Mars would be about fifteen minutes minimum. To the Asteroids, it gets up around half to three quarters of an hour. To Ganymede and the other Moons of Jupiter, it would be just about 2,000 seconds. This means you'd order a move—a small and gentle one—and wait forty to fifty minutes before you found out whether you'd made "Error #14" and goofed again. Then go have lunch, and come back to see what you'd accomplished on this move. After taking your siesta, you could come back for another move. By the time some critical control components broke down three years later, you could have looked at maybe two acres of Ganymede.

The recent article we ran on the design and building of a Mars Rover Robot—MR Robot—gave some notion of just what it will take to develop and build an instrumented probe that can actually explore an area of Mars. Landing gadgets that can do no more than look at the adjoining suburban-building-lot size area isn't going to tell you much more about Mars than such a device landed on Earth would tell you about this planet. Try samples of the Sahara, the Gobi, Death Valley, the Sinai Peninsula and the Antarctic Plateau and you might get a somewhat unrealistic picture of the planet Earth.

I'd love to see those laboratory scientists trying to remote-control a Mars probe, with an eight-minute-each-way feedback loop.

Of course, the instrumented probes *do* have the advantage that they report what they were told to, and, unlike human observers, don't see things they weren't told to look for.

The Editor.



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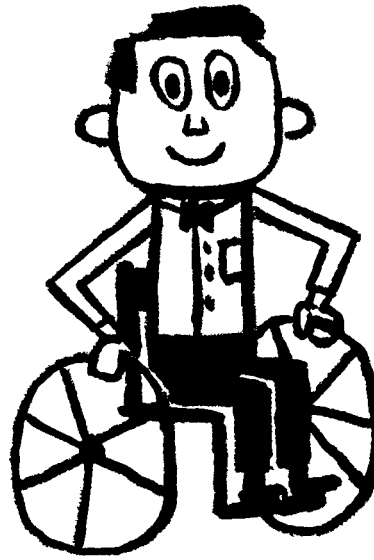

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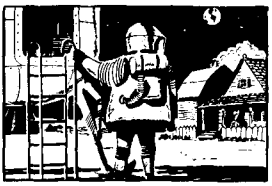

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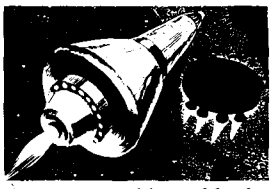

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